Siyavula: Life Sciences Grade 10

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C O N N E X I O N S

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Subject Orientation[1]

What is Life Sciences?

- "Life Sciences" is the scientific study of living things from molecular level to their interactions with one another and their environments.

- Life Sciences is the study of Life at various levels of organisation and comprises a variety of sub-disciplines, or specialisations, such as :

- Biochemistry
- Biotechnology
- Microbiology
- Genetics
- Zoology
- Botany
- Entomology
- Physiology (plant and animal)
- Anatomy (plant and animal)
- Morphology (")
- Taxonomy (")

Environmental Studies

- Sociobiology (animal behaviour

- Scientists continue to explore the unknown. Why is the climate changing? What is making the universe expand? What causes the Earth's magnetic field to change? What, exactly, is the human mind? No-one knows for sure.

Why study Life Sciences?

Here are some reasons:

- To increase knowledge of key biological concepts, processes, systems and theories.
- To develop the ability to critically evaluate and debate scientific issues and processes
- To develop scientific skills and ways of thinking scientifically that enable you to see the flaws in pseudo-science in popular media.
- To provide useful knowledge and skills that are needed in everyday living

[1] This content is available online at <http://cnx.org/content/m41334/1.1/>.

- To create a greater awareness of the ways in which biotechnology and knowledge of Life Sciences have benefited humankind.
- To show the ways in which humans have impacted negatively on the environment and organisms living in it.
- To develop a deep appreciation of the unique diversity of biomes In Southern Africa, both past and present, and the importance of conservation.
- To create an awareness of what it means to be a responsible citizen in terms of the environment and life-style choices that they make.
- To create an awareness of the contributions of South African scientists
- To expose you to the range and scope of biological studies to stimulate interest in and create awareness of possible specialisations
- to provide sufficient background for further studies and careers in one or more of the biological sub-disciplines

An A-Z of Possible careers in Life Sciences

Ever wondered what you can do with Life Sciences after school? Well here are some careers which you could study further for:

- Agronomist – someone who works to improve the quality and production of crops
- Animal scientist – a researcher in selecting, breeding, feeding and managing of domestic animals, such as cows, sheep and pigs
- Biochemist – someone who specializes in the chemical composition and behaviour of living things and help with work in finding cures for diseases, for example.
- Botanist – someone who studies plants and their interaction with the environment
- Developmental biologist – studies the development of an animal from the fertilized egg through to birth
- Ecologist – a person who looks at the relationships between organisms and their environment
- Food Scientist – someone who studies the biological, chemical and physical nature of food to ensure it is safely produced, preserved and stored, and they also investigate how to make food more nutritious and flavourful.
- Geneticist – a researcher who studies inheritance and conducts experiments to investigate the causes and possible cures of inherited genetic disorders and how traits are passed on from one generation to the next.
- Horticulturalist – a person who works in orchards and with garden plants and they aim to improve growing and culturing methods for home owners, communities and public areas.
- Marine biologist – a researcher who studies the relationships between plants and animals in the ocean and how they function and develop. They also investigate ways to minimize human impact on the ocean and its effects, such as over fishing and pollution.
- Medical illustrator – someone who illustrates and draws parts of the human body to be used in textbooks, publications and presentations.
- Microbiologist – a researcher who studies microscopic organisms such as bacteria, viruses, algae and yeast and looks at how these organisms affect animals and plants.
- Nutritionist – someone who gives advice to individuals or groups on good nutritional practices to either maintain or improve their health.
- Paleontologist – a reasreacher who studies fossils of plants and animals to trace and reconstruct evolution, prehistoric environments and past life.
- Pharmacologist – a scientist who develops new or improved drugs or medicines and conducts experiments to test the effects of drugs and any undesirable side effects.
- Physiologist – a researcher who studies the internal functions animals and plants during normal and abnormal conditions.
- Science teacher – someone who helps students in different areas of science, whether it is at primary

school, high school or university.

- Science writer – someone who writes and reports about scientific issues, new discoveries or researcher, or health concerns for newspapers, magazines, books, television and radio.
- Zoologist – a researcher who studies the behaviour, interactions, origins and life processes of different animal groups.

Chapter 1

Life at the molecular, celluar and tissue level

1.1 The Chemistry of Life[1]

Molecules for lifeAll matter around us, living and non-living (biotic and abiotic) is made up of tiny building blocks called atoms. An atom is the smallest particle of an element and when two or more atoms combine, a molecule is formed. For example, a molecule of oxygen is formed from two oxygen atoms: O + O = O2.Compounds are molecules that have atoms of two or more elements. An example is water, which has two hydrogen atoms and one oxygen atom: 2H + O = H2O.

Here is a video that explains the concept of chemical compounds: http://www.youtube.com/watch?v=-HjMoTthEZ0Molecules and compounds are the building blocks that make up a cell which is the basic unit of life.The most important elements found in living organisms:

Carbon Iron = FeCarbon = CHydrogen = HOxygen = ONitrogen = NPhosphorus = PSodium = NaPotassium = KCalcium = CaSulfur = SIodine = IIron = FeMagnesium - Mg

The important compounds found in cells are carbohydrates, lipids (fats), proteins, nucleic acids and water.

Chemical compounds can be divided into two groups:

- inorganic molecules
- organic molecules

Inorganic compounds

- these do not contain carbon, e.g. water and mineral salts.
- one exception is carbon dioxide, a gas that forms part of the atmosphere and is released during cellular respiration.

1.1.1 Water

- Regulates the body temperature – sweating cools the body because evaporation causes cooling.
- Important body constituent – 65% of the body is composed of water.
- Transport medium – e.g. water enables food to move along your alimentary canal; water transports corpuscles and nutrients in the blood.
- Lubricating agent – e.g. tear fluid in the eyes; saliva in the mouth; vaginal fluids.
- Solvent for biological chemicals i.e. substances dissolve in water.

[1] This content is available online at <http://cnx.org/content/m41327/1.1/>.

- Medium in which chemical reactions can occur e.g. in the cytoplasm of the cell.
- Hydrolysis reactions i.e. water is needed to break down large molecules into smaller molecules e.g. during digestion of food.

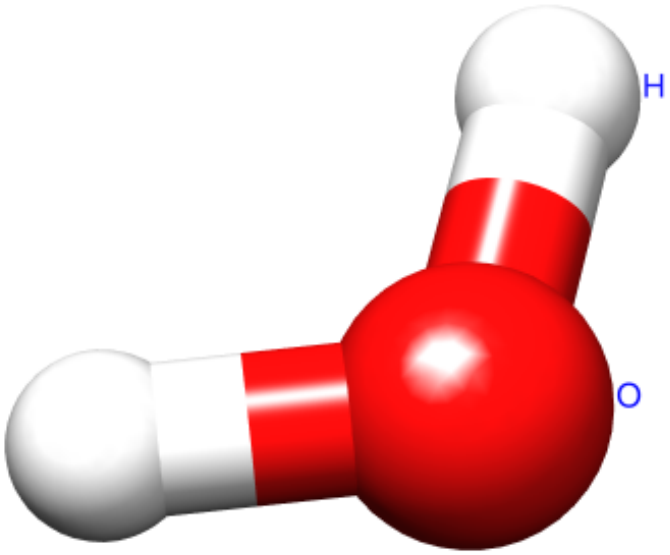


Figure 1.1

Figure X. Illustration of water molecule: the Oxygen atom is in red and the Hydrogen atoms are white. http://www.flickr.com/photos/fogonthedowns/3117758148/

Minerals

These are inorganic compounds that living organisms need in order to remain healthy. Minerals are needed to take part in chemical reactions in life processes. Plants obtain their minerals from the soil. Minerals can also be supplied to plants in the form of fertilisers. Animals get their mineral nutrients from the food they eat. Different foods contain different mineral sources, e.g. dairy products such as milk and cheese contain calcium.

Macroelements are nutrients that are required in large amounts

Microelements are nutrients that are required in minute quantities.

1.1.1.1 Minerals required by humans

Table of mineral nutrients required by humans

	Mineral	Food Source	Function	Deficiency disease
Macroelement	Nitrogen (N)	Meat, fish, eggs, soya	Part of DNA & RNA Part of amino acid	Limits growth
	Phosphorus (P)	Meat, dairy	Part of DNA & RNABone & teeth development	Poor development of bones & teethInhibits growth
	Calcium (Ca)	Dairy, bones of fish	Bone & teeth developmentAction of muscles & nerves	Poor development of bones & teethRickets (children)
	Potassium (K)	Bananas, meat, dairy	Muscle activity	Poor muscle controlArrhythmic heartbeat
	Sodium (Na)	Table salt	Osmosis	Muscle cramps
	Sulphur (S)	Meat, dairy, eggs, legumes	Component of some amino acids in the hair & skin	Disorder unlikely
Microelement	Iron (Fe)	Meat, legumes	Component of haemoglobin (in red blood cells)	Anaemia (pale complexion, tired)
	Iodine (I)	Seafood, iodated salt	Component of the hormone thyroxin	Goitre (swollen thyroid gland)
	Zinc (Zn)	Seafood, meat	Male reproductive system.	Prostate problems

Table 1.1

1.1.1.2 Minerals required by plants

Table of mineral nutrients required by plants

	Mineral	Source	Function	Deficiency disease
Macroelement	Calcium (Ca)	Inorganic fertilisers, Ca ions in the soil	Cell wall component	Chlorosis

continued on next page

	Magnesium (Mg)	Inorganic fertilisers, Mg ions in the soil	Found in the chlorophyll molecule	Chlorosis
	Nitrogen (N)	Inorganic fertilisers, special bacteria	Found in proteins and nucleic acids	Stunted growthUndersized leaves
	Phosphorus (P)	Inorganic fertilisers, Low amounts in the soil	Found in cell membranes and nucleic acids; necessary for a strong root system	Poor root growthStunted growth
	Potassium (K)	Inorganic fertilisers, K ions in the soil	Required by photosynthetic and respiratory enzymes	ChlorosisDead spots on the leaves
	Sulfur (S)	Inorganic fertilisers	Required for root development and protein synthesis	Chlorosis
Microelement	Iron (Fe)	Fe ions in the soil, inorganic fertilisers	Component of the enzyme that makes chlorophyll	Chlorosis
	Zinc (Zn)	Zn ions in the soil, inorganic fertilisers	Part of many different enzymes	Poor leaf growth
	Sodium (Na)	Na ions in the soil, inorganic fertilisers	Maintains salts and water balance	Reduced growth
	Iodine (I)	Inorganic fertilisers, Iodine ions in the soil	Required for energy release during respiration	Poor growth

Table 1.2

Indigenous knowledge systems

Figure 1.2

Minerals in traditional foods: Marogo, umfino (isiZulu)

Marogo is grown in southern Africa for its leaves, which are eaten like spinach. The young plants can be grown 25 cm apart and can yield between 30 and 60 tons per hectare. Maroga uses bright sunlight effectively for photosynthesis and has a relatively low water consumption, which means that it is well adapted to hot and arid conditions in Southern Africa. The leaves are a valuable source of protein, and the minerals iron, magnesium and calcium. People should be encouraged to grow this crop, especially in rural areas where it could help to reduce malnutrition in children.

Photo: http://www.flickr.com/photos/oakleyoriginals/4639259240/sizes/l/in/photostream/

1.1.1.3 Use of fertilisers

- All plants require inorganic nutrients for growth. Artificial fertilisers contain inorganic nutrients. The main nutrients found in fertilisers are nitrogen, in the form of nitrates, phosphorous, in the form of phosphates and potassium, magnesium, calcium and other minerals. These artificial fertilisers should

only be used in soils that lack nutrients. An example would be where crops are grown and regularly harvested from the same soil. The soil then becomes overused and has fewer mineral nutrients

Poor farming practice leaches nutrients from the soil, therefore farmers use large amounts of fertilisers to make up for reduced soil fertility. This excess fertiliser is washed into streams, rivers, lakes and oceans where it starts a process called eutrophication.

- the abundant supply of nutrients causes rapid growth of algae
- the decomposition of the plants by bacteria decreases the concentration of oxygen in the water, which leads to the death of animal life. See Figure below.

1.1.2

http://www.flickr.com/photos/48722974@N07/4859897047/

Figure exemplifying eutrophication in coastal water bodies. The process begins with excessive inputs of nutrients such as nitrogen and phosphates into the system. These nutrients lead to a substantial increase in primary production (e.g.algae) which eventually results in the transport of large amounts of organic material to the sea bottom. As a result, oxygen use increases as organic material starts to decompose while upward delivery of oxygen through the water column is limited by heat and/or salt water concentration differences. Bottom-dwelling organisms suffocate and/or migrate to other areas. This is a negative impact of fertiliser misuse on the environment. Credit: Pew Trusts

1.1.3 Organic Compounds

- consists of chains of carbon atoms
- always contain the elements of carbon (C), and hydrogen (H)
- many organic compounds contain oxygen (O)
- they may also contain elements such as nitrogen (N), and phosphorus (P)
- over 90% of all known compounds are organic.
- carbohydrates, proteins, lipids (fats), nucleic acids and enzymes are all organic compounds that have different functions in living organisms
- produced by living organisms (plants, animals and bacteria)

Here is a video that introduces the various organic compounds:http://www.youtube.com/watch?v=nMevuu0Hxuc[2]

1.1.3.1 Lipids (fats & oils)

1.1.3.1.1 Structure

- Consists of the elements C, H,
- The ratio of H:O is far greater than 2:1
- The monomers (building blocks) of fats are glycerol and fatty acids
- 1 glycerol + 3 fatty acids ==> lipid + water
- This is a condensation reaction as a larger molecule is built up from two or more smaller molecules, forming water as a by-product.

[2] http://www.youtube.com/watch?v=nMevuu0Hxuc

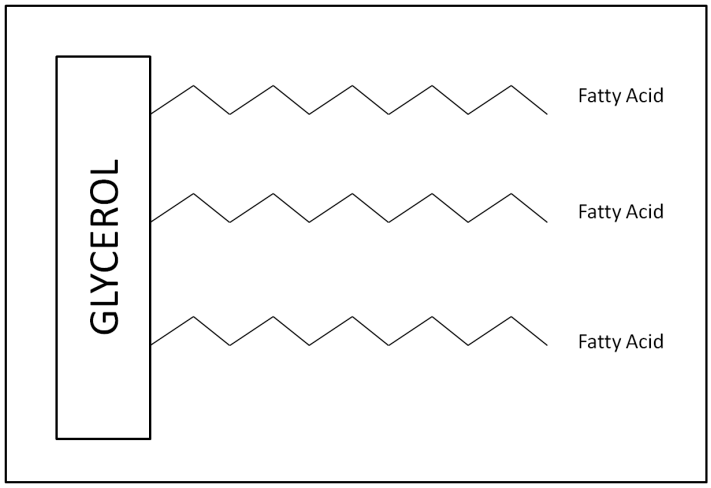


Figure 1.3

Structure of a simple lipid molecule

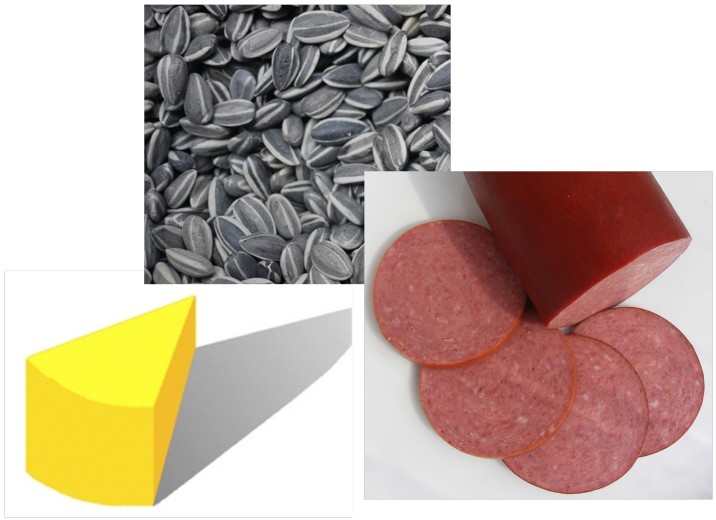


Figure 1.4

Figure X. Sunflower seeds, cheese and meat products are some food examples that contain fats.
Cheese: http://www.flickr.com/photos/fetchcomms/4124861105/sizes/m/in/photostream/
Sunflower seeds: http://www.flickr.com/photos/philhawksworth/5079811846/sizes/l/in/photostream/[3]
Meat: http://www.flickr.com/photos/fetchcomms/4124861105/sizes/m/in/photostream/

[3]http://www.flickr.com/photos/philhawksworth/5079811846/sizes/l/in/photostream/

1.1.3.1.2 Properties

- Floats on top of water because it is less dense than water
- Does not mix with water: lipids are hydrophobic
- Saturated fats (e.g. animal fat) are solid at room temperature while monounsaturated / polyunsaturated fats are liquids at room temperature
- Fats emulsify (break into tiny droplets) when mixed with an alkaline solution (like bile)
- Fats are soluble (dissolves) in alcohol

1.1.3.1.3 Biological importance of fats

- Important source of reserve energy: fats yield more energy (gram for gram) than any other organic compound.
- Insulation of heat.
- Protection from shock (shock-absorber).
- Phospholipids form part of the cell membrane and thus control the entry /exit of substances into and out of the cell.

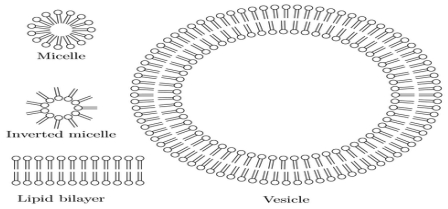


Figure 1.5

Figure X. Simple diagram of a phospholipid bilayer that forms part of the cell membrane.
Photo: http://www.texample.net/tikz/examples/lipid-vesicle/

1.1.3.2 Proteins

1.1.3.2.1 Structure of proteins

- Consists of the elements carbon (C), hydrogen (H), oxygen (O), Nitrogen (N) and sometimes phosphorus (P) and sulphur (S).
- The monomers (building blocks) of proteins are amino acids.
- More than three amino acids combine to form a polypeptide.
- More than 50 amino acids combine to form a protein.
- There are 20 different types of amino acids.
- The type of protein depends on ...

- The number of amino acids
- The type of amino acids used
- The sequence of amino acids
- The shape of the protein molecule

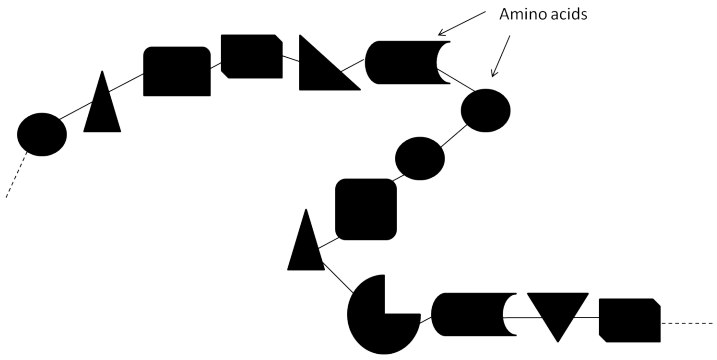


Figure 1.6

Figure X. Simple diagram of a protein molecule composed of different amino acids.

1.1.3.2.2 Properties

- Solubility in water depends on the amino acid components
- Protein structure and function is closely linked
- Proteins denature (change shape and function due to the hydrogen bonds breaking) at high temperatures.
- Proteins are inactive at low temperature.
- Proteins denature in unfavourable pH levels.

1.1.3.2.3 Biological importance

- For growth and repair of tissue.
- Globin carries oxygen in the erythrocytes (red blood corpuscles)
- Antibodies are composed of proteins and provide the body with

immunity to germs.

- Enzymes are composed of proteins and speed up chemical reactions.
- Proteins are a reserve source of energy

Here is a video describing the role of proteins in the body:
http://www.youtube.com/watch?v=T500B5yTy58&feature=related[4]

1.1.3.3 Carbohydrates

1.1.3.3.1 Structure

- Consists of the elements C, H and O.
- The ratio of H:O atoms = 2:1.
- The monomers of carbohydrates are called monosaccharides.
- Monosaccharides include glucose, fructose and galactose.

[4] http://www.youtube.com/watch?v=T500B5yTy58&feature=related

- Disaccharides form when two monosaccharides join together in a

condensation reaction.

- Glucose + glucose ==> maltose (malt sugar) + water
- Glucose + fructose ==> sucrose (cane sugar) + water
- Glucose + galactose ==> lactose (milk sugar) + water
- Polysaccharides form when three or more monosaccharides join

together.

- Polysaccharides include starch (stored in plants), cellulose (forms

part of the cell wall in plants) and glycogen (stored in animals).

1.1.3.3.2

Figure X. Illustration of glucose monosaccharide molecule: the Oxygen atom is in red and the Carbon atoms are dark grey and the hydrogen atoms are light grey.
http://library.thinkquest.org/11226/main/s07.htm[5]
Table of some common carbohydrates

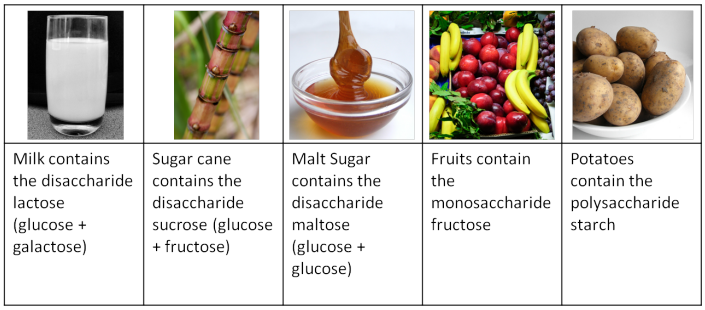


Figure 1.7

Potatoes: http://www.flickr.com/photos/fotoosvanrobin/3762764923/
Fruits: http://www.flickr.com/photos/malte_s/5019886730/
Milk: http://www.flickr.com/photos/striatic/131012552/
Maltose sugar: http://www.flickr.com/photos/fotoosvanrobin/2933442985/
Sugar cane: http://www.flickr.com/photos/tinyfroglet/5583775843/sizes/l/in/photostream/

1.1.3.3.3 Properties

- Mono & disaccharides are soluble (dissolve in) water.
- Polysaccharides are insoluble in water because they are very

large molecules.

[5] http://library.thinkquest.org/11226/main/s07.htm

1.1.3.3.4 Biological importance

- Most important source of energy (e.g. glucose)
- Important source of reserve energy (e.g. starch)
- Forms part of the DNA molecule (deoxyribose)
- Forms part of the RNA molecule (ribose)
- Forms part of the ATP (adenosine triphosphate) molecule which

is the most important energy carrier in the body.

- Glucose is soluble in water and thus affects the water potential of cells.
- Cellulose is an important component of plant cell walls and is a

source of fibre in our diet.

1.1.3.4 Vitamins

1.1.3.4.1 Functions of vitamins

- They facilitate growth.
  - They increase the body's resistance to infection.
  - They regulate certain body processes.

Table of some important Vitamins

NAME	FUNCTION	DEFICIENCY	SOURCE
Vitamin AWithstands heat.	Good night vision.Healthy mucous membrane.Bone and teeth development.	night blindnessstunted growth	dairy productseggsyellow fruit and vegetables
Vitamin B1 (thiamine).Destroyed by heating.	Facilitates growth.Helps with digestion.Nerve functioning.	beri- beripoor muscle control	cerealsmeatlegumes
Vitamin B3(niacin)	Forms an active part of the co-enzyme NAD and NADH (hydrogen carriers in cellular respiration.	Pellagra (symptoms include dermatitis, diarrhoea, dementia)	whole-wheatLean meatnuts
Vitamin C (ascorbic acid)Destroyed by heating.	Formation of collagen (protein).Healing of wounds.Resistance to infection.	Scurvy.Damage to blood vessels.Slow healing of wounds.	fresh fruitgreen vegetables

continued on next page

Vitamin DFat soluble-Withstands heat	Bone development	rickets (in children)osteomalacia (adults)	oily fishliveregg yolk
Vitamin Efat soluble-withstands heat	Prevents oxidation of vit. A and unsaturated fatty acids	Sterility	egg yolkvegetable oil-dairy

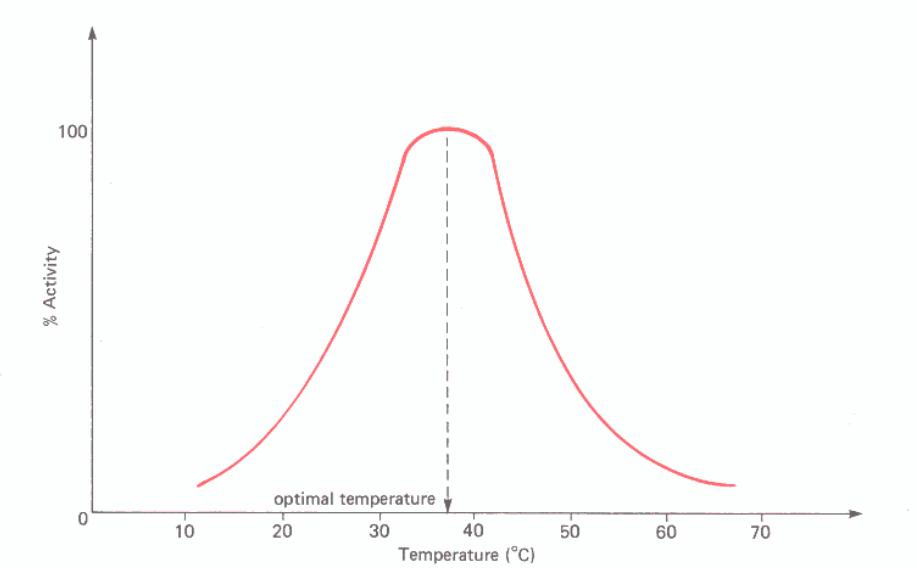
Table 1.3

NB. Too much vitamin A and D is dangerous.
Enzymes
What are enzymes?

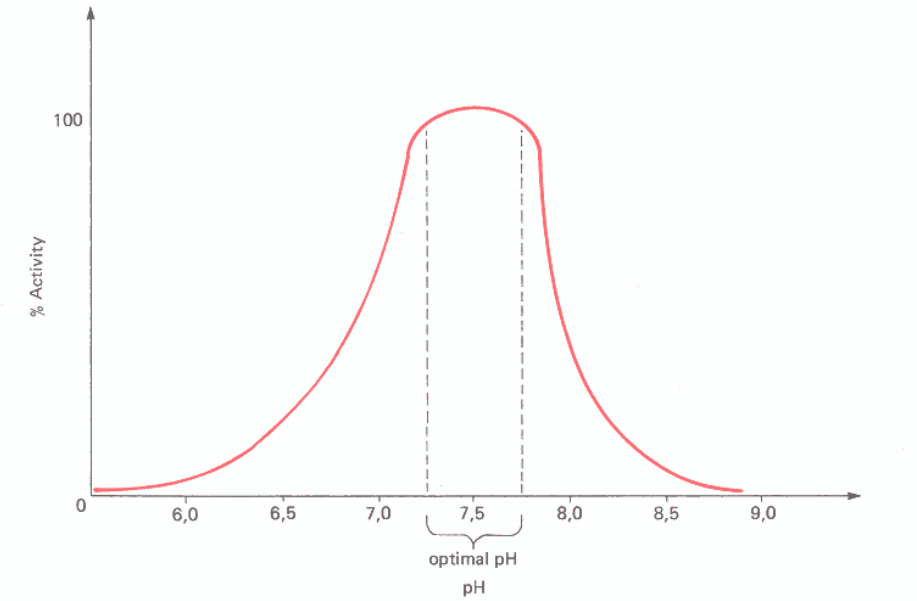
- Enzymes are a special type of protein
- Enzymes are biological catalysts that speed up chemical reactions by lowering the activation energy, but is unaffected by the reaction.
- Enzymes can thus be used over and over again

Properties of enzymes

- Enzymes are highly specific i.e. each of the thousands of chemical reactions in the body has their own specific enzyme.
- Enzymes can be used over and over again.
- Enzymes are sensitive to temperature. They are inactive at low temperatures and denature (change shape permanently) at high temperatures.
- Enzymes are sensitive to pH (degree of acidity) and denature in unfavourable pH mediums.



A graphical representation of the influence of temperature on the functioning of a human enzyme.



A graphical representation of the influence of pH on the working of an enzyme.

Figure 1.8

1.2.6.3Functioning of enzymes

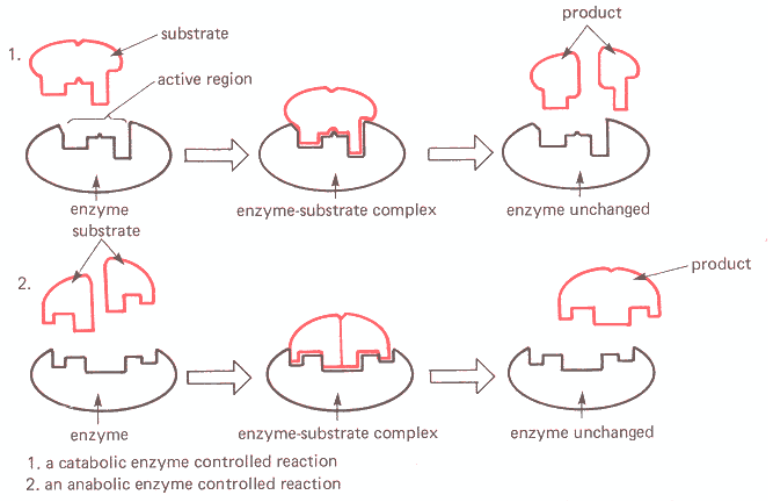


Figure 1.9

1. Catabolic enzyme reactions: A larger molecule is broken down by an enzyme into smaller molecules.

sucrase
E.g. Sucrose ——[U+F0E8] glucose + fructose

1. Anabolic enzyme reaction: Smaller molecules are combined by an enzyme to form larger molecules.

sucrase
E.g. Glucose + fructose ——[U+F0E8] sucrose
Enzymes in everyday life
The properties of enzymes to control reactions have been widely used for commercial purposes. Some of these uses are listed below:

- biological washing powders contain enzymes such as lipase and protease which assist in the breakdown of stains caused by foods, blood, fat or grease. These biological washing powders save energy as they are effective at low temperatures.
- Meat tenderisers are enzymes which are obtained from fruits such as papaya or pineapple. The fruit contains enzymes that break down proteins.
- Lactose – free milk is manufactured primarily for people whom are lactose intolerant. Lactose intolerant individuals lack the enzyme lactase that digests lactose (milk sugar). Lactose is pre-digested by adding lactase to the milk.

Indigenous knowledge systems

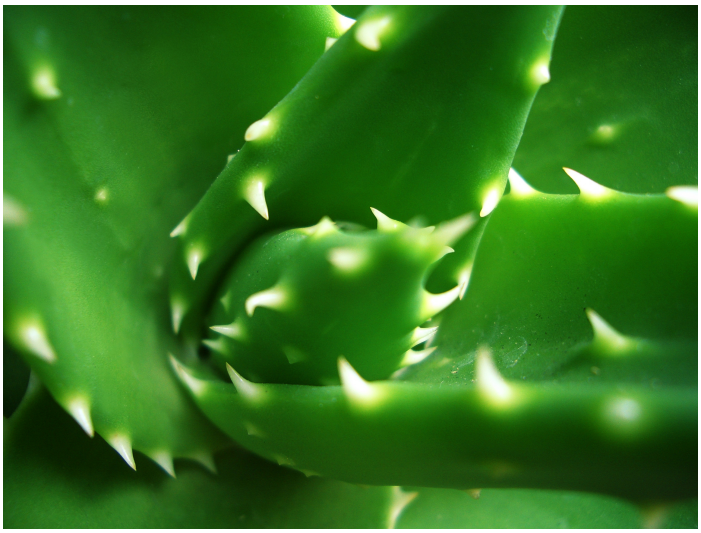


Figure 1.10

Figure. X. Aloe vera has been used for centuries in traditional medicine. Aloe vera contains many enzymes including carboxypeptidase which helps reduce inflammation and pain. Photo:http://www.flickr.com/photos/nagarazoku/31662791/sizes/o/in/photostream/[6]

Nucleic Acids

These are compounds that are found in all cells

Functions

- play an important role in controlling the structure and functions of the cell.

Structure of nucleic acids

- contain the elements carbon (C), hydrogen (H), oxygen (O), nitrogen (N) and phosphorous (P)
- are made up of building blocks called nucleotides
- two types of nucleic acids
    - Ribonucleic Acid (RNA)
    - Deoxyribonucleic Acid (DNA)
    - the table below shows the differences between RNA and DNA

RNA	DNA
RNA is found in the cell cytoplasm and on the ribosomes	DNA is found in the nucleus

continued on next page

[6] http://www.flickr.com/photos/nagarazoku/31662791/sizes/o/in/photostream/

RNA plays a role in building the required ;proteins from the amino acids	DNA stores the information from which amino acids must be produced in each type of cell

Table 1.4

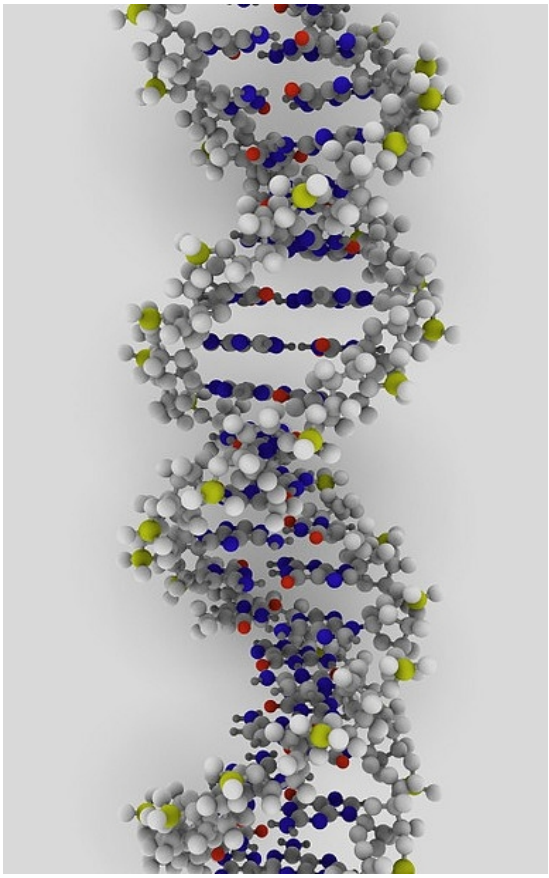


Figure 1.11

Figure X. Model of the DNA double helix structure where every ball represents a an atom and every colour a different element. For interest: which element represents which colour?

Dna molecule: http://www.flickr.com/photos/ynse/542370154/sizes/z/in/photostream/[7]

Here is a video showing the structure of DNA:http://www.youtube.com/watch?v=qy8dk5iS1f0&feature=related[8]

SUMMARY OF KEY CONCEPTS : CHEMISTRY OF LIFE

1.Molecules for Life

- Organic molecules contain the elements carbon, hydrogen and oxygen.
- Carbohydrates, proteins, lipids (fats), nucleic acids and enzymes are organic compounds important for living organisms.

[7] http://www.flickr.com/photos/ynse/542370154/sizes/z/in/photostream/

[8] http://www.youtube.com/watch?v=qy8dk5iS1f0&feature=related

- Inorganic compounds can contain combinations of elements, but do not generally contain hydrogen and carbon together.
- Water is the most vital inorganic compound in living organisms.

2.Organic compounds

- The most important role of carbohydrates is to provide living organisms with a source of energy.
- Carbohydrates form structural components such as cell walls in plants.
- Monosaccharides are the simplest of carbohydrates (glucose and fructose)
- Disaccharides consist of two monosaccharides linked together.
- Polysaccharides are macromolecules which are polymers (many monomers), each monomer being a glucose molecule.
- Lipids are formed when one glycerol molecule bonds, by condensation, with three fatty acid molecules.
- Lipids supply living organisms with energy as well as forming structural components (cell membranes).
- Proteins are made up of amino acids to form longs chains known as polypeptides.
- Proteins are important in the cell structure and function of organelles and cell membranes.
- Enzymes are protein compounds that act as catalysts speeding up chemical reactions.
- Enzymes are sensitive to pH and temperature.
- Explanation of the workings of enzymes using the lock-and-key method.
- DNA is found in the nucleus and RNA found in the cytoplasm.
- Nucleic acids are responsible for controlling a cell's structure and function.
- Vitamins are organic compounds essential for animals in small quantities to help maintain a healthy body.
- A lack of vitamins in the diet may lead to various deficiency diseases.

3.Inorganic compounds

- Water makes up 60% of the mass of cells and is essential for metabolic processes in both plants and animals.
- Normal growth, development and function require inorganic compounds such as minerals.
- Macro and micro nutrients are need by plants and animals in large amounts or small amounts, respectively.
- Animals obtain minerals from their diets.
- Plants absorb minerals through their roots from the soil.
- Eutrophication is cause by the overuse of inorganic fertilisers.

1.2 Cells - The Basic Units of Life[9]

1.2.1 Unit 1.2 Cells - The Basic unit of life

1.2.1.1 Molecular make up of cells

History of microscopyBecause of the quality of the glass and the light source used in the earliest light microscopes they had poor resolution and a magnification power of about 10 times.

Robert Hooke built an early version of the compound microscope. This allowed him to observe the structures in cork which he referred to as "cellulae", which means "small rooms" in Latin. The word “cell” was therefore coined by Robert Hooke.

(public domain images)

[9]This content is available online at <http://cnx.org/content/m41381/1.1/>.

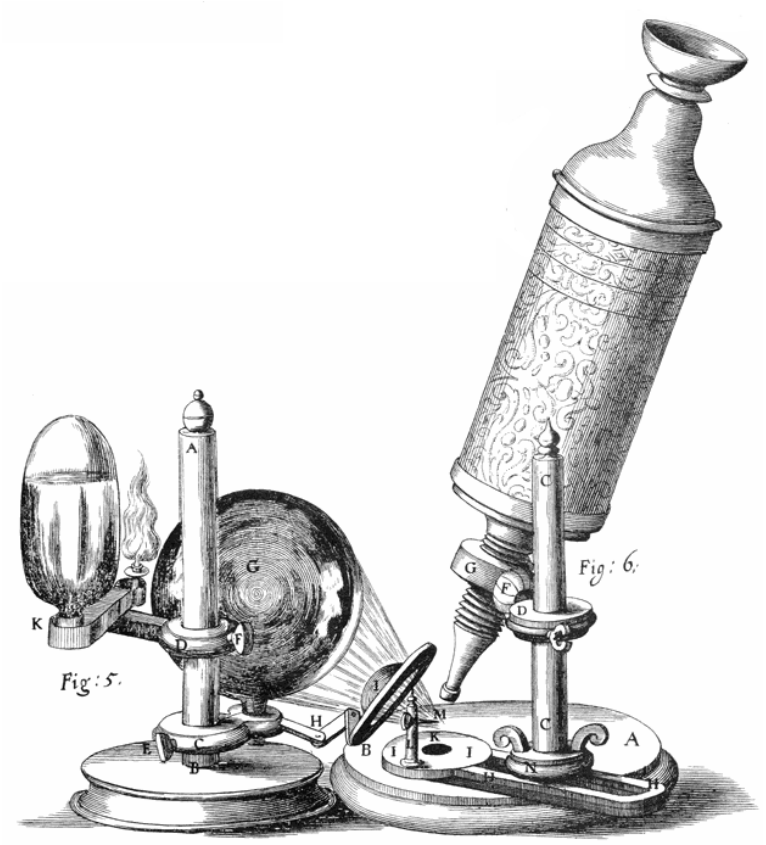


Figure 1.12

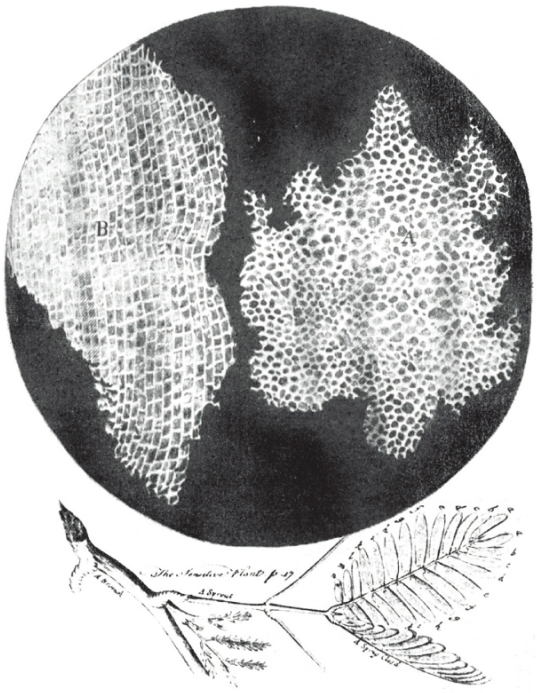


Figure 1.13

By grinding his own lenses Antonie van Leeuwenhoek was able to improve the magnification to over 200 times. Antonie van Leeuwenhoek is considered to be the father of microscopy and is credited with bringing the microscope to the attention of biologists, even though simple magnifying lenses were already being produced in the 16th century. He was the first scientist to observe unicellular organisms under the microscope, which he named "animalcules".

The first electron microscope, which was invented by Leó Szilárd, was built in 1931 and was capable of 400x magnification

1.2.1.1.1 Discovery of Cells

A cell is the smallest unit that can carry out the processes of life and as such is the basic unit of all living things

Using a light microscope, Theodor Schwann, a zoologist, and Matthias Jakob Schleiden, a botanist, first suggested in 1839 that cells were the basic unit of life. “Later, in 1858, the German doctor Rudolf Virchow observed that cells divide to produce more cells. He proposed that all cells arise only from other cells. The collective observations of all three scientists form the cell theory.”

The modern priniciples of cell theory state that:

- The cell is the more basic building block of all living organisms.
- All cells arise from pre-existing cells by cell division.
- All cells have the same basic chemical composition in organisms of similar species.

- Cells contain hereditary information (DNA) which is passed from cell to cell during cell division.
- Unicellular organisms are made up of one cell. Multicellular organisms are composed of multiple cells.

Follow the url below to view an interactive timeline of the history of cell theory and the role microscopes played in in early cell theory :

http://www.tiki-toki.com/timeline/entry/11813/The-history-of-cell-theory/ (made by katie - all images are attributed or public domain, the basic dates are from: http://en.wikipedia.org/wiki/Timeline_of_microscope_technology[10])Types of microscopy

Type of microscope	Defining characteristic
Light microscopy	visible light (photons) are transmitted through or reflected from a specimen. - http://en.wikipedia.org/wiki/Light_microscopy#Optical_microscop
Electron microscopy	In an electron microscope, a beam[18] of electrons[19] is used to illuminate the object. This allows much higher resolution than the light-powered optical mircroscope because electrons have much shorter wave lenghts than visible light (photons).
	Scanning electron microscope SEM looks at the surface of bulk objects by scanning the surface with a fine electron beam and measuring reflection (wikipedia)
	A transmission electron microscope (TEM) are used to produce images of the inner structure of a specimen since electrons are transmitted through the specimen.

Table 1.5

How to use a light microscope can be viewed at http://www.youtube.com/watch?v=FuDcge0Zuak[20] Light microscope:

[10] http://en.wikipedia.org/wiki/Timeline_of_microscope_technology
[17] http://en.wikipedia.org/wiki/Light_microscopy#Optical_microscopy
[18] http://en.wikipedia.org/wiki/Particle_beam
[19] http://en.wikipedia.org/wiki/Electron
[20] http://www.youtube.com/watch?v=FuDcge0Zuak

Figure 1.14

Need annotated image with functional description of different parts.Scanning electron microscope image: A natural community of bacteria growing on a single grain of sand. The sand was collected from intertidal sediment on a beach near Boston, MA in September 2008 and imaged using a Scanning Electron Microscope (SEM).

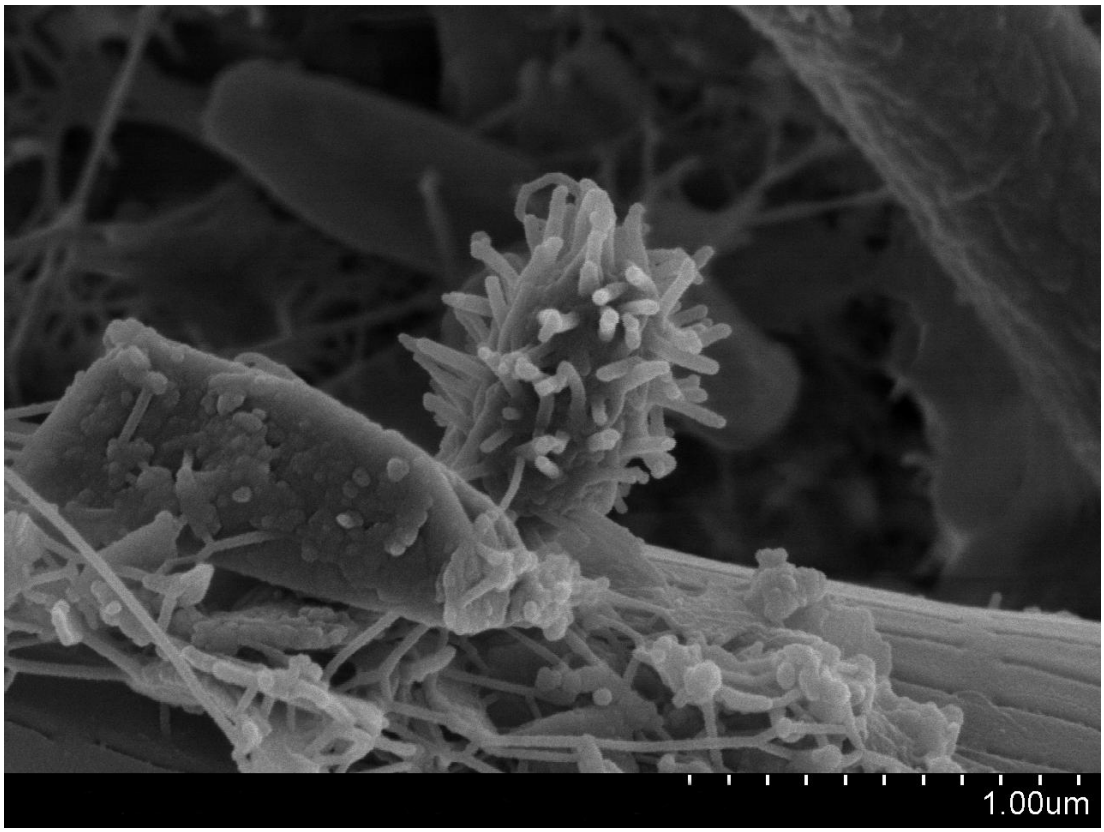


Figure 1.15

(You are free to distribute this image while giving attribution in the following manner:"Image courtesy of the Lewis Lab at Northeastern University. Image created by Anthony D'Onofrio, William H. Fowle, Eric J. Stewart and Kim Lewis.")These pollen grains[21] taken on an SEM show the characteristic depth of field[22] of SEMmicrographs[23]

[21] http://en.wikipedia.org/wiki/Pollen_grain
[22] http://en.wikipedia.org/wiki/Depth_of_field
[23] http://en.wikipedia.org/wiki/Micrograph

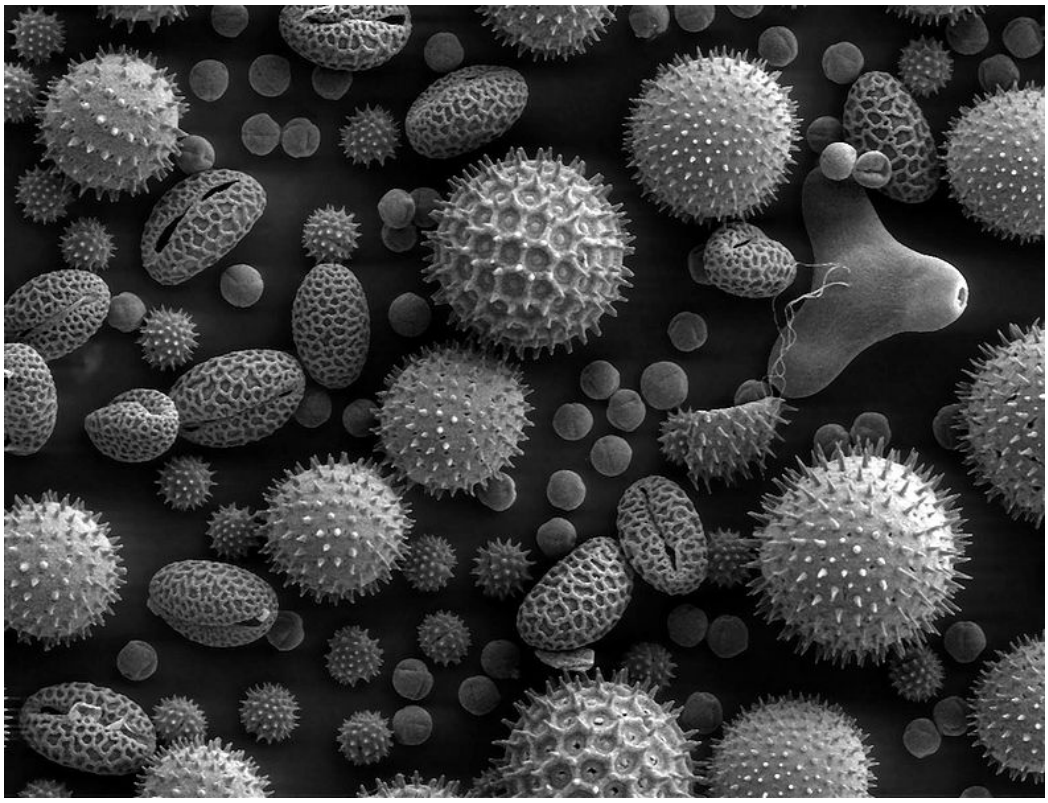


Figure 1.16

Transmission electron microscope image:

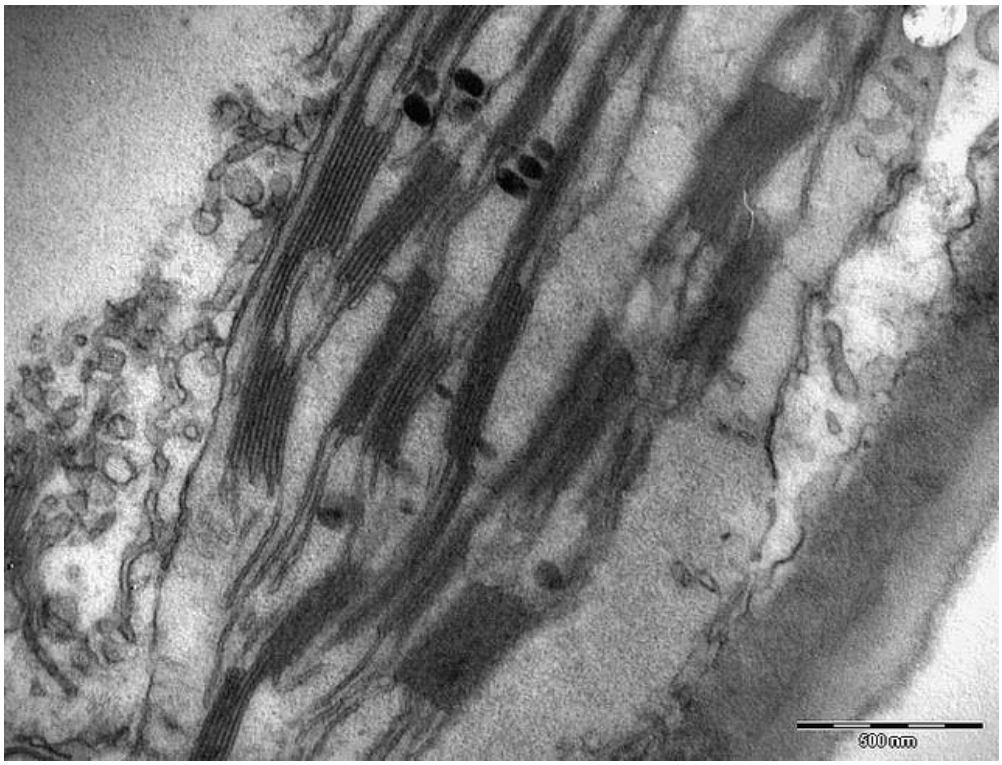


Figure 1.17

Cell structure and function: roles of organelles:

Interactively explore the organelles of plant and animal cells in three dimensions:http://learn.genetics.utah.edu/content/begin/cells/insideacell/[24]

An introduction to the cell, discussing various parts of the cell is available at: http://www.youtube.com/user/khanacademy#p/c/7A9646BC5110CF64/33/Hmwvj9X4GNY[25] (21:03). In this video, the process of diffusion is described using simple illustrations:

http://commons.wikimedia.org/wiki/File:Biological_cell.svg

[24] http://learn.genetics.utah.edu/content/begin/cells/insideacell/

[25] http://www.youtube.com/user/khanacademy#p/c/7A9646BC5110CF64/33/Hmwvj9X4GNY

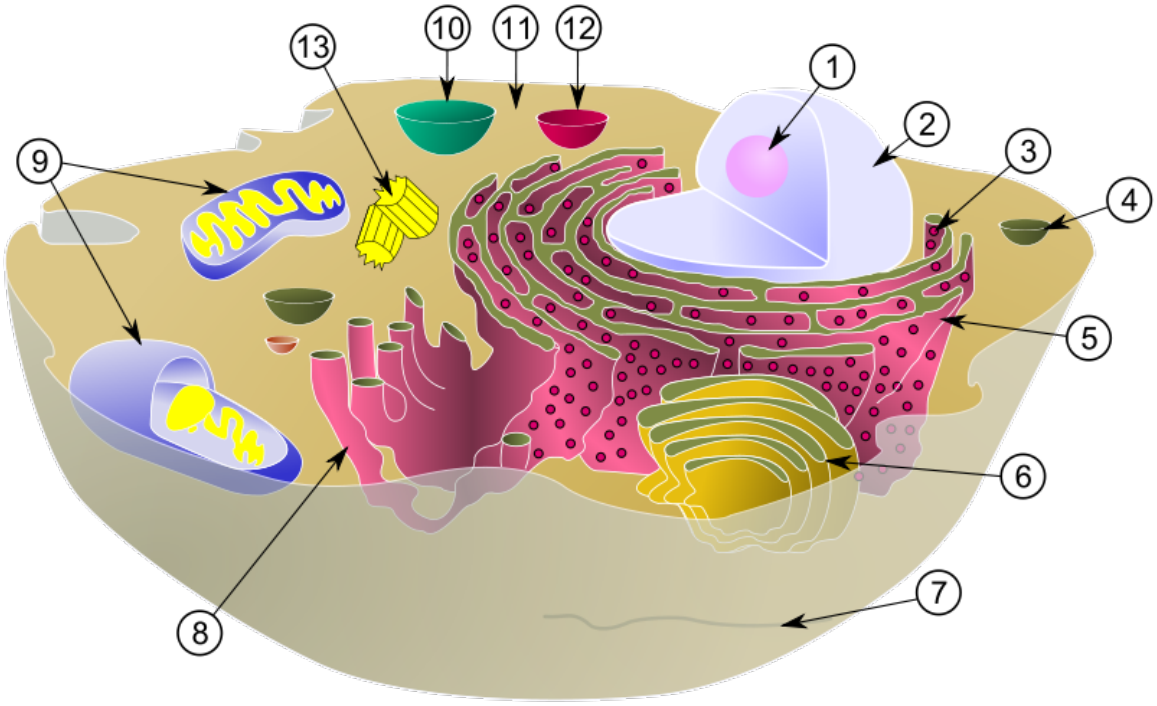


Figure 1.18

1. Nucleolus[26]
2. Nucleus[27]
3. Ribosome[28]
4. Vesicle[29]
5. Rough endoplasmic reticulum[30]
6. Golgi apparatus[31] (or "Golgi body")
7. Cytoskeleton[32]
8. Smooth endoplasmic reticulum[33]
9. Mitochondrion[34]
10. Vacuole[35]
11. Cytosol[36]
12. Lysosome[37]
13. Centriole[38]

[26] http://en.wikipedia.org/wiki/Nucleolus
[27] http://en.wikipedia.org/wiki/Cell_nucleus
[28] http://en.wikipedia.org/wiki/Ribosome
[29] http://en.wikipedia.org/wiki/Vesicle_(biology)
[30] http://en.wikipedia.org/wiki/Endoplasmic_reticulum#Rough_ER
[31] http://en.wikipedia.org/wiki/Golgi_apparatus
[32] http://en.wikipedia.org/wiki/Cytoskeleton
[33] http://en.wikipedia.org/wiki/Endoplasmic_reticulum#Smooth_ER
[34] http://en.wikipedia.org/wiki/Mitochondrion
[35] http://en.wikipedia.org/wiki/Vacuole
[36] http://en.wikipedia.org/wiki/Cytosol
[37] http://en.wikipedia.org/wiki/Lysosome
[38] http://en.wikipedia.org/wiki/Centriole

1.2.1.1.2 The cell membrane

The cell membrane (also called the plasma membrane) forms the outer layer of the cell and consists mainly of lipid and protein molecules. The cell membrane serves to separate the cell from its external environment and allows only certain molecules into and out of the cell. The ability to allow only certain molecules in or out of the cell is referred to as selective permeability or semipermeability. Proteins that are associated with the plasma membrane determine which molecules can pass through the membrane. The cytoplasm refers to the gel-like material within the cell that holds the organelles. The protoplasm refers to the cell membrane, cytoplasm and organelles.

The plasma membrane is discussed at http://www.youtube.com/watch?v=-aSfoB8Cmic[39] .

1.2.1.1.3 Fluid Mosaic Model

S.J. Singer and G.L. Nicolson proposed the Fluid Mosaic Model in 1972. This model describes the structure of cell membrane as fluid because the lipids and proteins, which make up the membrane, can move around in the membrane. Some of these proteins extend all the way through the bilayer, and some only partially across it. These membrane proteins act as transport proteins and receptors proteins.

A further description of the fluid mosaic model can be viewed at http://www.youtube.com/watch?v=ULR79TiUj80[40] (1:27).

Discuss osmosis and diffusion:

http://www.khanacademy.org/video/diffusion-and-osmosis?playlist=Biology

Still needs to be done.

1.2.1.1.4 Cytoplasm

The gel-like material within the cell that holds the organelles is called cytoplasm. The cytoplasm plays an important role in a cell, serving as a "jelly" in which organelles are suspended and held together by a fatty membrane. The cytosol, which is the watery substance that does not contain organelles, is made up of 80% to 90% water.

Functions of the cytoplasm:

- Provides mechanical support to the cell by exerting pressure against the cell's plasma membrane which helps keep the shape of the cell.
- Acts as the site of biochemical reactions such as protein synthesis.
- Provides a storage area for small carbohydrate, lipid and protein molecules.??

1.2.1.1.5 The Nucleus

The nucleus is a membrane-enclosed organelle found in most eukaryotic cells. This membrane is referred to as the nuclear envelope and separates the content of the nucleus from the cytoplasm. Many tiny holes called nuclear pores are found in the nuclear envelope. These nuclear pores help to regulate the exchange of materials (such as RNA and proteins) between the nucleus and the cytoplasm.The nucleus is the largest organelle in the cell and contains most of the cell's genetic information (mitochondria also contain DNA, called mitochondrial DNA, but it makes up just a small percentage of the cell's overall DNA content).

The nucleus contains the cell's genetic material of the cell or DNA. DNA occurs as chromosomes in the cell, structures which can be seen under a microscope. Before the cell divides, the chromatin coil up more tightly and form chromosomes.

[39] http://www.youtube.com/watch?v=-aSfoB8Cmic
[40] http://www.youtube.com/watch?v=ULR79TiUj80

1.2.1.1.6 Mitochondria

A mitochondrion is referred to as the "power house" of the cell since it is the main site of energy production. Energy is produced from organic compounds to produce adenosine tri-phosphate (ATP). The mitochondrion is surrounded by a double membrane. The number of mitochondria in a cell depends on the cell's energy needs. For example, active human muscle cells may have thousands of mitochondria, while less active red blood cells do not have any.

Interesting fact: mitochondria are believed to have originated from free-living prokaryotes that infected ancient eukaryotic cells. In this symbiotic relationship, the invading prokaryotes supplied extra energy in the form of ATP to the host and in turn could survive in a protected environment.

1.2.1.1.7 Endoplasmic Reticulum

The endoplasmic reticulum (ER) is located in the cytoplasm and is connected to the nuclear envelope. The ER consists of a network of phospholipid membranes that form hollow tubes, flattened sheets, and round sacs. These flattened, hollow folds and sacs are called cisternae.

There are two types of endoplasmic reticulum:

- Rough endoplasmic reticulum (RER) which is covered with ribosomes, giving this structure its' "rough" appearance.
- Smooth endoplasmic reticulum (SER) which does not have any ribosomes attached to it and. Functions of the SER include lipid synthesis, calcium ion storage and drug detoxification..

1.2.1.1.8 Ribosomes

Ribosomes are small organelles which are the site of protein synthesis. While some ribosomes are attached to the RER, others may be found in the cytoplasm.

1.2.1.1.9 Golgi Apparatus

The Golgi apparatus (also referred to as the Golgi body) is a large organelle that is made up of a stack of membrane-covered disks called cisternae. The Golgi apparatus is responsible for the modification, sorting and packaging if different substances for secretion out of the cell, or for use within the cell. The Golgi apparatus is found close to the nucleus of the cell where it modifies proteins that have been delivered in transport vesicles from the RER.

Nucleus, ER and Golgi apparatus (http://commons.wikimedia.org/wiki/File:Nucleus_ER_golgi.jpg)

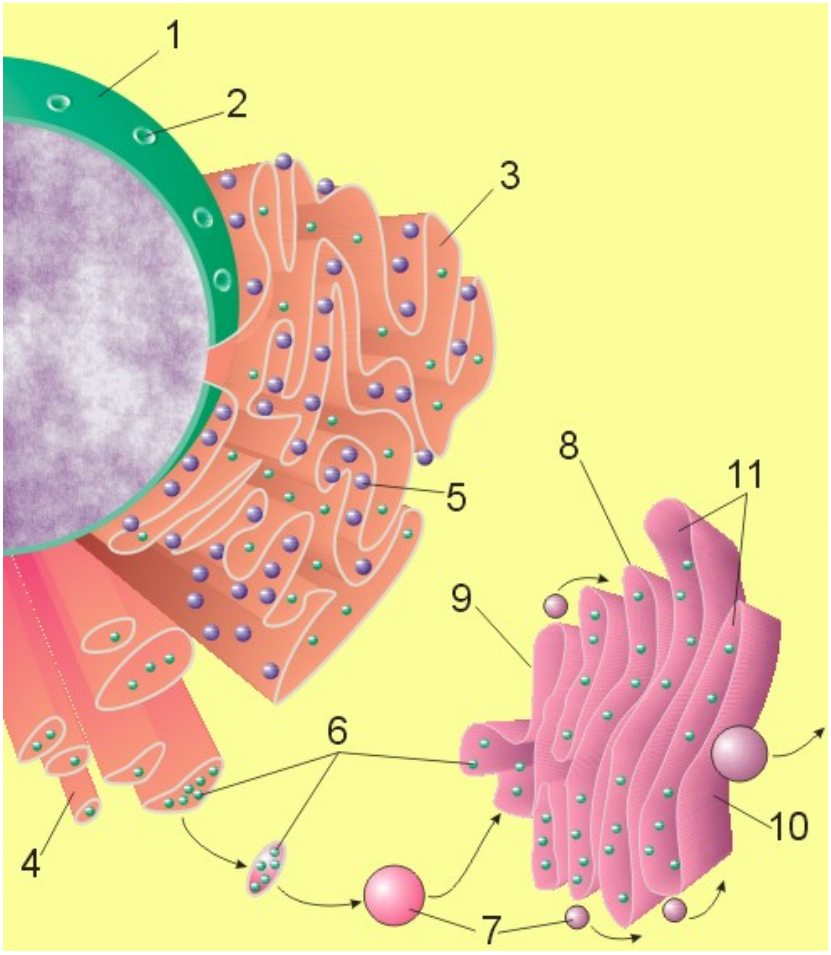


Figure 1.19

1. Nuclear membrane
2. Nuclear pore
3. Rough endoplasmic reticulum (rER)
4. Smooth endoplasmic reticulum (sER)
5. Ribosome attached to rER
6. Macromolecules
7. Transport vesicles
8. Golgi apparatus
9. Cis face of Golgi apparatus
10. Trans face of Golgi apparatus
11. Cisternae of Golgi apparatus

1.2.1.1.10 Structures unique to animal cells:

1.2.1.1.10.1 Vesicles

A vesicle is a small, membrane-bound spherical sac which facilitates the metabolism, transport and storage of molecules. Many vesicles are made in the Golgi apparatus and the endoplasmic reticulum, or are made from parts of the cell membrane. Vesicles can be classified by their contents and function.

- Transport vesicles transport molecules within the cell.
- Lysosomes are formed by the Golgi apparatus and contain powerful enzymes that can potentially digest the cell. This compartmentalisation therefore protects the cell agains being digested by it's own enzymes. Lysosomes play a role in protecting the cell by breaking down (digesting) harmful cell products, invading organisms, waste materials, and cellular debris in the cell. Lysosomes also break down cells that are ready to die, a process called autolysis.
- Peroxisomes are vesicles that use oxygen to break down toxic substances in the cell and are common in the liver and the kidney. Peroxisomes are named for the hydrogen peroxide (H2O2) that is produced when they break down organic compounds. Hydrogen peroxide is toxic, and in turn is broken down into water (H2O) and oxygen (O2) molecules.

1.2.1.1.10.2 Structures unique to plant cells: http://commons.wikimedia.org/wiki/File:Plant_cell_structure.

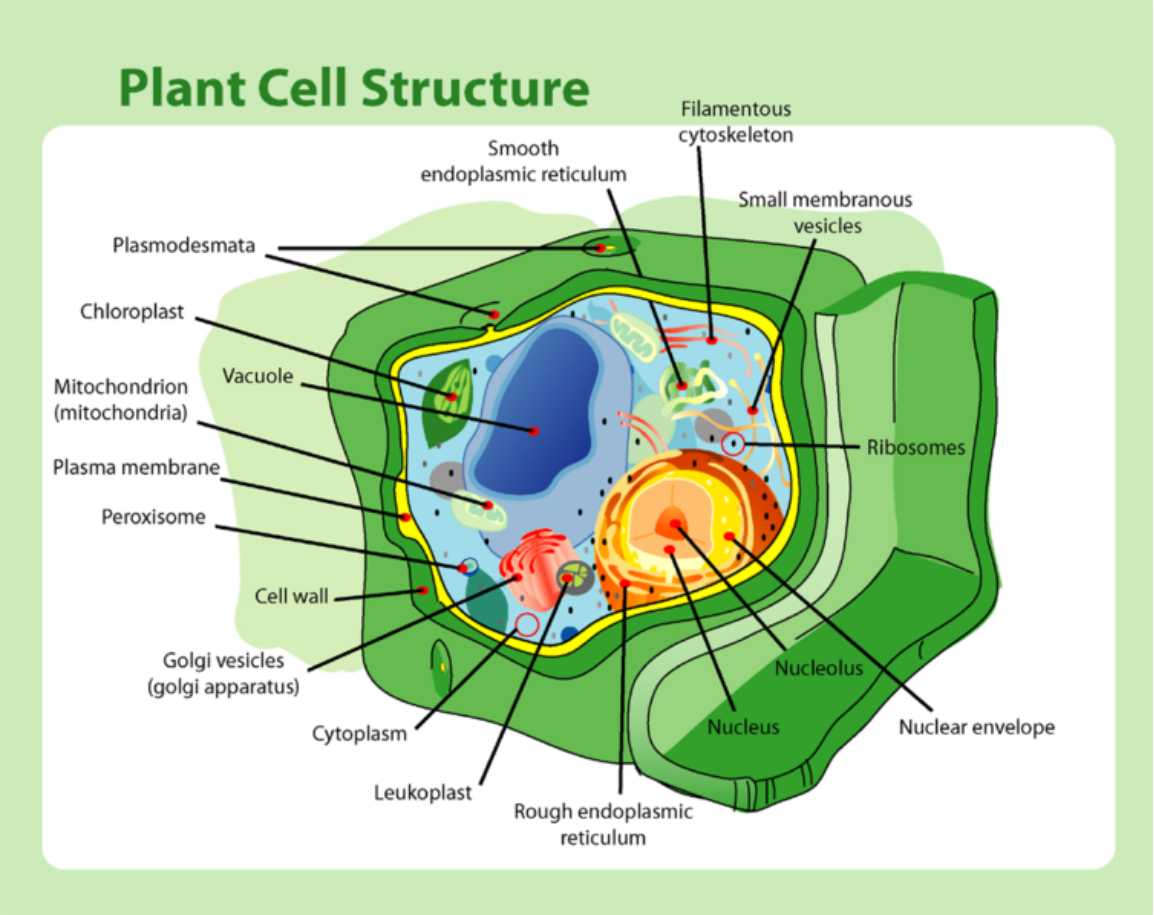


Figure 1.20

1.2.1.1.10.3 Vacuoles

Vacuoles are membrane-bound, fluid-filled organelles that occur in the cytoplasm of most plant cells. They perform secretory, excretory, and storage functions. The fluid inside the vacuole consists of water, mineral salts, sugars and amino acids. Plants usually have one main vacuole referred to as the central vacuole, which is responsible for maintaining the shape of the cell. If the vacuoles do not contain sufficient fluid, the pressure exerted on the cell wall is diminished and eventually the plant will wilt. The selectively permeable single membrane that surrounds the vacuole is called the tonoplast.

1.2.1.1.10.4 Cell Wall

The cell wall is a rigid non-living layer that is found outside the cell membrane and surrounds the cell. The cell wall consists of cellulose, protein and other polysaccharides. The cell wall provides structural support and protection. The cell wall is completely permeable to water and mineral salts. Pores in the cell wall, called plasmodesmata, allow water and nutrients to move between cells. The cell wall also prevents the plant

cell from bursting when water enters the cell.

1.2.1.1.10.5 Plastids

Plastids are membrane-bound organelles in plant cells.

Interesting fact: "Plastids contain their own DNA and some ribosomes, and scientists think that plastids are descended from photosynthetic bacteria that allowed the first eukaryotes to make oxygen."

The main types of plastids and their functions are:

- Chloroplasts are the site of photosynthesis. They produce sugar by utilizing light energy from the sun and carbon dioxide from the atmosphere.
- Chromoplasts make and store pigments that give petals and fruit their orange and yellow colors.
- Leucoplasts are responsible for storage of starch and are located in roots and non-photosynthetic tissues of plants.

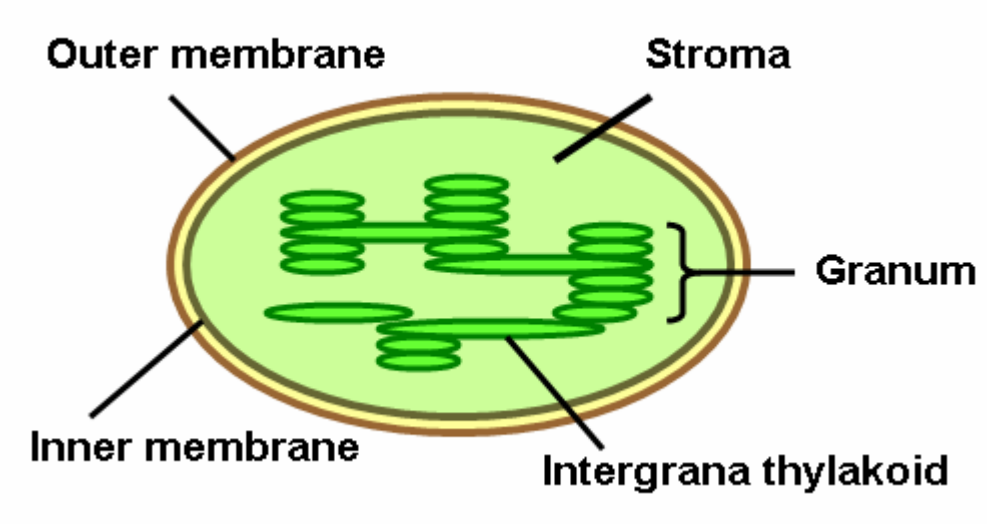


Figure 1.21

Glossary:Terminology & definitions http://www.ck12.org/flexbook/chapter/2409:chloroplast

The organelle of photosynthesis; captures light energy from the sun and uses it with water and carbon dioxide to make food (sugar) for the plant.

cell wall

A rigid layer that is found outside the cell membrane and surrounds the cell; provides structural support and protection.

cytoplasm

The gel-like material within the cell that holds the organelles.

cytoskeleton

A cellular "scaffolding" or "skeleton" that crisscrosses the cytoplasm; helps to maintain cell shape, it holds organelles in place, and for some cells, it enables cell movement.

endoplasmic reticulum (ER)

A network of phospholipid membranes that form hollow tubes, flattened sheets, and round sacs; involved in transport of molecules, such as proteins, and the synthesis of proteins and lipids.

Fluid Mosaic Model

Model of the structure of cell membranes; proposes that integral membrane proteins are embedded in the phospholipid bilayer; some of these proteins extend all the way through the bilayer, and some only partially across it; also proposes that the membrane behaves like a fluid, rather than a solid.

gene

A short segment of DNA that contains information to encode an RNA molecule or a protein strand.

Golgi apparatus

A large organelle that is usually made up of five to eight cup-shaped, membrane-covered discs called cisternae; modifies, sorts, and packages different substances for secretion out of the cell, or for use within the cell.

integral membrane proteins

Proteins that are permanently embedded within the plasma membrane; involved in channeling or transporting molecules across the membrane or acting as cell receptors.

intermediate filaments

Filaments that organize the inside structure of the cell by holding organelles and providing strength.

lipid bilayer

A double layer of closely-packed lipid molecules; the cell membrane is a phospholipid bilayer.

lysosome

A vesicle that contains powerful digestive enzymes.

membrane protein

A protein molecule that is attached to, or associated with the membrane of a cell or an organelle.

microfilament

Filament made of two thin actin chains that are twisted around one another; organizes cell shape; positions organelles in cytoplasm; involved in cell-to-cell and cell-to-matrix junctions.

microtubules

Hollow cylinders that make up the thickest of the cytoskeleton structures; made of the protein tubulin, with two subunits, alpha and beta tubulin; involved in organelle and vesicle movement; form mitotic spindles during cell division; involved in cell motility (in cilia and flagella).

mitochondria (mitochondrion)

Membrane-enclosed organelles that are found in most eukaryotic cells; called the "power plants" of the cell because they use energy from organic compounds to make ATP.

multicellular organisms

Organisms that are made up of more than one type of cell; have specialized cells that are grouped together to carry out specialized functions.

nucleus

The membrane-enclosed organelle found in most eukaryotic cells; contains the genetic material (DNA).

peripheral membrane proteins

Proteins that are only temporarily associated with the membrane; can be easily removed, which allows them to be involved in cell signaling.

peroxisomes

Vesicles that use oxygen to break down toxic substances in the cell.

phospholipid

A lipid made up of up of a polar, phosphorus-containing head, and two long fatty acid, non-polar "tails." The head of the molecule is hydrophilic (water-loving), and the tail is hydrophobic (water-fearing).

plasma membrane

Phospholipid bilayer that separates the internal environment of the cell from the outside environment.

ribosomes

Organelles made of protein and ribosomal RNA (rRNA); where protein synthesis occurs.

selective permeability

The ability to allow only certain molecules in or out of the cell; characteristic of the cell membrane; also called the cell membrane.

transport vesicle

A vesicle that is able to move molecules between locations inside the cell.

vacuole

Membrane-bound organelles that can have secretory, excretory, and storage functions; plant cells have a large central vacuole.

vesicle

A small, spherical compartment that is separated from the cytosol by at least one lipid bilayer.

1.3 Cell Cycle and Mitosis[41]

1.3.1 The Cell Cycle and Mitosis

1.3.1.1 Intoduction

The cell cycle is the series of events that takes place in a cell[42] leading to its division and duplication (replication). In cells without a nucleus (prokaryotic[43]), the cell cycle occurs via a process termed binary fission[44] . In cells with a nucleus (eukaryotes[45]), the cell cycle can be divided in two brief periods: interphase[46] —during which the cell grows, accumulating nutrients needed for mitosis and duplicating its DNA[47] —and the mitosis[48] (M) phase, during which the cell splits itself into two distinct cells, often called "daughter cells". The cell-division cycle is a vital process by which a single-celled fertilized egg[49] develops into a mature organism, as well as the process by which hair[50] , skin[51] , blood cells[52] , and some internal organs are renewed.

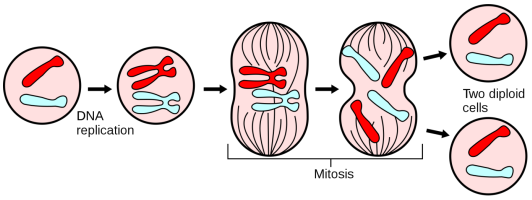


Figure 1.22

Diagram - Cell division.

[41] This content is available online at <http://cnx.org/content/m41393/1.1/>.
[42] http://en.wikipedia.org/wiki/Cell_(biology)
[43] http://en.wikipedia.org/wiki/Prokaryotic
[44] http://en.wikipedia.org/wiki/Binary_fission
[45] http://en.wikipedia.org/wiki/Eukaryotes
[46] http://en.wikipedia.org/wiki/Interphase
[47] http://en.wikipedia.org/wiki/DNA_replication
[48] http://en.wikipedia.org/wiki/Mitosis
[49] http://en.wikipedia.org/wiki/Fertilized_egg
[50] http://en.wikipedia.org/wiki/Hair
[51] http://en.wikipedia.org/wiki/Skin
[52] http://en.wikipedia.org/wiki/Blood_cell

1.3.1.2 Phases

The cell cycle consists of four distinct phases: G[53] 1[54] phase[55] , S phase[56] (synthesis), G[57] 2[58] phase[59] (collectively known as interphase[60]) and M phase[61] (mitosis). M phase is itself composed of two tightly coupled processes: mitosis, in which the cell's chromosomes[62] are divided between the two daughter cells, and cytokinesis[63] , in which the cell's cytoplasm[64] divides in half forming distinct cells. Activation of each phase is dependent on the proper completion of the previous one. Cells that have temporarily or reversibly stopped dividing are said to have entered a resting state called G[65] 0[66] phase[67] .

Diagram - Schematic of the cell cycle. outer ring: I = Interphase[68] , M = Mitosis[69] ; inner ring: M = Mitosis[70] , G1 = Gap 1[71] , G2 = Gap 2[72] , S = Synthesis[73] ; not in ring: G0 = Gap 0/Resting[74] .[1][75]

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[53] http://en.wikipedia.org/wiki/G1_phase
[54] http://en.wikipedia.org/wiki/G1_phase
[55] http://en.wikipedia.org/wiki/G1_phase
[56] http://en.wikipedia.org/wiki/S_phase
[57] http://en.wikipedia.org/wiki/G2_phase
[58] http://en.wikipedia.org/wiki/G2_phase
[59] http://en.wikipedia.org/wiki/G2_phase
[60] http://en.wikipedia.org/wiki/Interphase
[61] http://en.wikipedia.org/wiki/Mitosis
[62] http://en.wikipedia.org/wiki/Chromosomes
[63] http://en.wikipedia.org/wiki/Cytokinesis
[64] http://en.wikipedia.org/wiki/Cytoplasm
[65] http://en.wikipedia.org/wiki/G0_phase
[66] http://en.wikipedia.org/wiki/G0_phase
[67] http://en.wikipedia.org/wiki/G0_phase
[68] http://en.wikipedia.org/wiki/Interphase
[69] http://en.wikipedia.org/wiki/Mitosis
[70] http://en.wikipedia.org/wiki/Mitosis
[71] http://en.wikipedia.org/wiki/G1_phase
[72] http://en.wikipedia.org/wiki/G2_phase
[73] http://en.wikipedia.org/wiki/S_phase
[74] http://en.wikipedia.org/wiki/G0_phase
[75] http://en.wikipedia.org/wiki/Cell_cycle#cite_note-isbn0-87893-106-6-0

State	Phase	Abbreviation	Description
quiescent/senescent	Gap 0[108]	G0	A resting phase where the cell has left the cycle and has stopped dividing.
Interphase[109]	Gap 1[110]	G1	Cells increase in size in Gap 1. The G[111]1[112] checkpoint[113] control mechanism ensures that everything is ready for DNA[114] synthesis.
	Synthesis[115]	S	DNA replication[116] occurs during this phase.
	Gap 2[117]	G2	During the gap between DNA synthesis and mitosis, the cell will continue to grow. The G[118]2[119] checkpoint[120] control mechanism ensures that everything is ready to enter the M (mitosis) phase and divide.

continued on next page

Cell division[121]	Mitosis[122]	M	Cell growth stops at this stage and cellular energy is focused on the orderly division into two daughter cells. A checkpoint in the middle of mitosis (Metaphase Checkpoint[123]) ensures that the cell is ready to complete cell division.

Table 1.6

Table – Phases of the cell cycle

[108] http://en.wikipedia.org/wiki/G0_phase
[109] http://en.wikipedia.org/wiki/Interphase
[110] http://en.wikipedia.org/wiki/G1_phase
[111] http://en.wikipedia.org/wiki/Cell_cycle_checkpoint#G1_.28Restriction.29_Checkpoint
[112] http://en.wikipedia.org/wiki/Cell_cycle_checkpoint#G1_.28Restriction.29_Checkpoint
[113] http://en.wikipedia.org/wiki/Cell_cycle_checkpoint#G1_.28Restriction.29_Checkpoint
[114] http://en.wikipedia.org/wiki/DNA
[115] http://en.wikipedia.org/wiki/S_phase
[116] http://en.wikipedia.org/wiki/DNA_replication
[117] http://en.wikipedia.org/wiki/G2_phase
[118] http://en.wikipedia.org/wiki/Cell_cycle_checkpoint#G2_Checkpoint
[119] http://en.wikipedia.org/wiki/Cell_cycle_checkpoint#G2_Checkpoint
[120] http://en.wikipedia.org/wiki/Cell_cycle_checkpoint#G2_Checkpoint
[121] http://en.wikipedia.org/wiki/Cell_division
[122] http://en.wikipedia.org/wiki/Mitosis
[123] http://en.wikipedia.org/wiki/Cell_cycle_checkpoint#Metaphase_Checkpoint

1.3.1.3 Stages of Mitosis

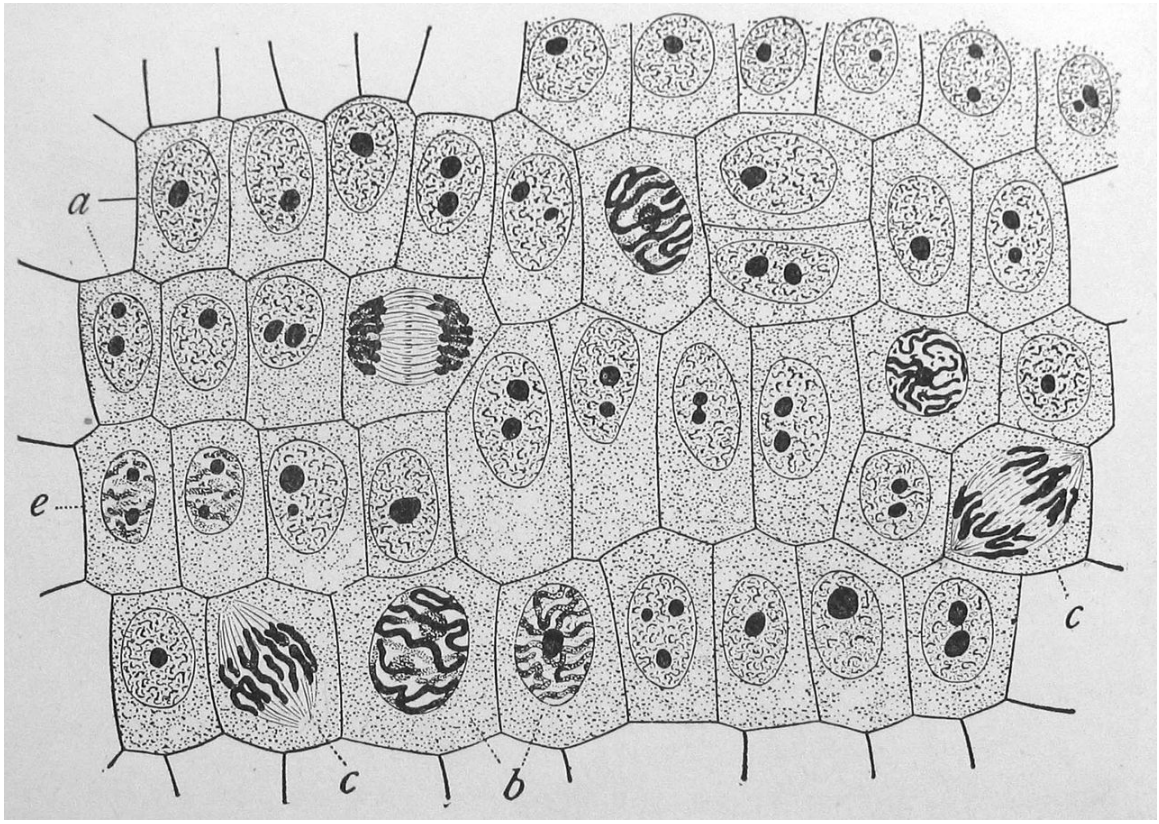


Figure 1.23

Diagram - allium cells in the different cycle of mitosis.

1.3.1.3.1 Interphase

- The cell spends most of its life in the interphase.
- During this phase the cell grows to its maximum size and performs its normal functions.

1.3.1.3.2 Prophase

- The chromatin (a protein that chromosomes are made of) condenses into chromosomes (human cells have 46 chromosomes – 23 from your father and 23 from your mother).
- The nuclear membrane disappears.
- The centriole splits and starts to move to opposite poles.
- Spindle threads form between the poles.

1.3.1.3.3 Metaphase

- Chromosomes lie on the equator of the cell.
- Unlike meiosis, homologous chromosomes are not side by side.

1.3.1.3.4 Anaphase

- The centromere splits.
- Each chromatid moves to opposite poles of the cell.
- Chromatids (now called daughter chromosomes) gather at opposite poles of the cell.

1.3.1.3.5 Telophase

- A nuclear membrane forms around each of the daughter chromosomes that have gathered at the poles.
- The cytoplasm then divides during a process called cytokinesis. Note –cytokinesis is not a stage of mitosis but the process of the cell splitting into two.
- In an animal cell an invagination or infolding will divide the cytoplasm.
- In a plant cell a cross wall divides the cytoplasm.

Animation – Cell cycle and stages of mitosis –
http://highered.mcgraw-hill.com/sites/0072495855/student_view0/chapter2/animation__how_the_cell_cycle_works.l

1.3.1.4 Summary of mitosis

- Two identical daughter cells are formed from the mother cell.
- Each daughter cell has the same number of chromosomes as the mother cell.
- Each daughter cell will grow to its maximum size.

1.3.1.5 Biological importance of mitosis

- Growth – Living tissue grows by mitosis e.g. bone and skin.
- Repair - Damaged and worn-out tissues are replaced with new cells by mitosis.
- Asexual reproduction - Single-celled (unicellular) organisms and bacteria often reproduce asexually by mitosis.

1.4 Unit_1.1_1.2_activities_assignments[125]

GRADE 10
LIFE SCIENCES
Strand 1:Life at molecular, cellular and tissue level
Topic: Organelle Project
Date:_____Name: _____
_____
Task 1:Cell Organelles
You are required to compile a reported on one of the organelles you have studies in class, or any other organelle you choose. Your report must include the following information.
Past

[124] http://highered.mcgraw-hill.com/sites/0072495855/student_view0/chapter2/animation__how_the_cell_cycle_works.html
[125] This content is available online at <http://cnx.org/content/m41368/1.1/>.

- The discovery of the organelle
- All past understanding of the organelles structure and/or function that has now changed
- The importance of the discovery of the organelle to cell science

Present

- The presently understood structure and function of the organelle
- A 2-dimensional picture of the organelle showing all the relevant structures of the organelle
- An electron-microscope picture of the organelle showing the structure of the organelle
- An understanding of the importance of the organelle to human survival

- Future

The future of the organelle – what remains to be discovered or fully understood?

Any important role of the organelle could potentially play with the development of future technology (i.e. in industry or medicine).

- Any other additional information or interesting facts you wish to include.

Presentation:

Your research must be presented in a booklet format. It must be neatly yet creatively set out. It shou8ld include a thorough and correctly structured bibliography.

You will be marked according to the attached rubric

Task 2

Diagrams of the cell are very well but they often give us the wrong impression about how complicated cells really are. You are to do an assignment that will help you understand the complexity of cells.

1. You are to find and submit a "hard copy" of 5 micrographs showing different cell organelles.
2. Of your five, you must draw and label two so that you can demonstrate your drawing, labeling and interpretive skill.

Pay close attention to the following:

- the organelles should each comfortably occupy an A5 page
- the organelles must each have a heading that includes the view, title and magnification.
- Drawings must follow the conventions you have learnt. One drawing must be the same size as the micrograph, the other must be exactly half the size. Your drawing must have a correct scale line.
- You must state the source of your micrographs AND according to the Harvard convention.
- Marks will be awarded for neatness: present your work as a uniform "set".
- Select your hardcopies well: they must be easily recognizable (i.e. YOU must know what they are) and of high quality. Your images may be of the same organelle but ONLY if the images show some significant variation.

Marks : [30]

- follow instructions : size, quantity, etc (5)
- images: choice, quality, headings, referenced (10)
- drawing: accuracy, realism, scale, labeling etc (10)
- effort : neatness, professionalism (5)

Due Date : _____

Presentation:

Your research is to be presented in booklet form. It must be neatly yet creatively set out. It should include a thorough and correctly structured bibliography

You will be marked according to the attached rubric
Your project is due on: _____
Marking Rubric
Organelle Project
Content:
Rankings system:
5 – Complete
4 – almost complete
3 – slightly incomplete
2 – incomplete
1 – lacking information

Assessing Knowledge	
Discovery of the organelle identified	
Story of the discovery of the organelle discussed and understood	
Future discoveries regarding the organelle discussed and understood	
Interpreting Knowledge	
Information on the present structure and function of the organelle discussed and understood	
2d picture of organelle provided and sufficiently detailed	
3d picture of organelle provided and sufficiently detailed	
Micrograph of organelle provided and sufficiently detailed	
Additional information supplied	
Understanding of content in everyday life	
The importance of the discovery of the organelle to science provided and understood	
The possible future role of the organelle provided, understood and relevant	
Exploring science in the past	
Past theories/understanding of the organelle that have changed discussed	
Communicating information	
Referencing technique correct	
Presentation neat	
Presentation creative	

Table 1.7

GRADE 10
LIFE SCIENCES
Strand 1:Life at molecular, cellular and tissue level
Topic: Vitamin Research Project

For humans to grow and be healthy, they require mineral salts and vitamins in addition to carbohydrates, proteins and lipids.

Vitamins are organic substances required in minute amounts for normal growth and activity of the body. They are obtained from natural food sources.

Minerals are inorganic substances produced when weak acids from soil organisms wear down rocks and cause minerals to dissolve in soil moisture. They are absorbed by plants directly from the soil. Humans obtain mineral salts from the digestion of plants or from eating animals that have eaten plants.

You are required to produce a TYPED POSTER presented on an A4 page.

MARK SCHEME	Mark
Biological name(s) of vitamin / mineral in heading	/ 2
Functions of vitamin / mineral in humans	/ 4
Types of food sources that are high in vitamin / mineral	/ 4
Deficiency symptoms / diseases	/ 4
Other interesting information about vitamin / mineral	/ 4
Size of poster. Layout is neat. Good use of space. Font shape & size is appropriate.	/ 4
Eye-catching. Colorful. Use of diagrams / pictures, etc	/ 4
Use of language. Age-appropriate. Own words.	/ 4
Only relevant information included.	/ 3
Concise. To-the-point. No repetition. Use of bullets.	/ 3
Adequate Bibliography supplied below	/ 4
TOTAL	/ 40

Table 1.8

GRADE 10
Life Science
Strand 1:Life at molecular, cellular and tissue level
Topic: Deficiency Diseases and
Disorders
____
Task 1
You are required to research ONE disorder/disease as indicated.
Anorexia nervosaGall stonesKwashiorkor
BulimianervosaGoutMarasmus
Hiatus herniaGoitrePellagra
Heartburn Gastric UlcerScurvy
Use keywords and short phrases to record your research, under the following headings:
Name of disease, description of symptoms of disease, cause, treatment.
(Include in your answer how it can be treated by nutrition, with home remedies, with medicines and/or natural remedies)
Task 2
You are required to present a short oral to the class about the disease/disorder.

	O marks	1 mark	2 marks	3 marks

continued on next page

Voice	Not clear at all	Clear in parts, butgenerally mumbled	Mumbled in parts, but generally clear	Clear throughout
Speech	Topic not addressedproperly	Topic addressed but generally ignored	Topic addressed-generally, but drifts slightly in parts.	Maintains topic-Throughout
Audience Response	Audience lost /not interested	Audience is engaged for part of the time	Audience shows interest	Audience is interestedand is engaged fully.
Preparation	Unprepared	Slightly prepared butgenerally indecisiveand fumbled	Generally well prepared,but vague or confusingin parts	Excellent preparation
Content	Lacks factual evidence – no research done	Some facts, but notenough to fill the speech	Facts all present , but no comprehensiveevaluation	Enough factualevidence, portrayed efficiently

Table 1.9

Task 3

You are required to take notes on FIVE of the diseases/disorders that you did not research yourself. You will then have information on 6 diseases/disorders – two of which must be Marasmus and Kwashiorkor. These will be your notes for this section.

GRADE 10

Life Science

Strand 1:Life at molecular, cellular and tissue level

Topic: Practical Activity : Construct a model of a simple molecule

_____

You are required to construct a model of the water molecule.

Water is an inorganic compound which is made up of two elements, hydrogen and oxygen. Each water molecule has to hydrogen atoms joined to one oxygen atom.

What you need:

- tooth picks
- jelly tots or polystyrene balls (colour the polystyrene balls different colours for the hydrogen and oxygen molecules)
- glue

Method

1.Choose a jelly tot or polystyrene to represent the hydrogen molecules

2.Choose a different colour of jelly tot or polystyrene to represent the oxygen molecules.

3.Attach the hydrogen to the oxygen using a tooth pick to illustrate the bonds between the molecules.

GRADE 10

Life Science

Strand 1:Life at molecular, cellular and tissue level

Topic: Practical Activity : Food Test

_____

1.Tests for presence of reducing sugars

What you need:

- two heat-resistant test tubes in a test tube rack
- 10 ml syringe or measuring cylinder
- 4 ml Benedicts solution
- 2ml milk
- 2 ml fruit juice
- water bath or beakers with hot water (+ 500C)

Method

- label the test tubes A and B
- add 2ml of milk to test tube A
- add 2ml fruit juice to test tube B
- add 2ml of Benedicts solution to each test
- gently shake the test to mix the test sample with the Benedicts solution
- Place the test tubes into the water bath or beaker with the hot water

Observation

- A precipitate forms indicating the presence of reducing sugars.
- The precipitate colour varies from yellow-green to brick red
- Low concentration of reducing sugar will have a yellow-green colour
- Higher concentration of reducing sugar will have a brick red colour

2.Test for starch
What you need:

- piece of potato or bread
- petri dish
- iodine solution
- dropper

Method

- place a piece of potato or bread in the petri dish
- using the dropper add a few drops of iodine solution onto the potato or bread

Observation

- the iodine turns blue black in the presence of starch

3.Test for the presence of lipids (fats)
What you need:

- ethanol
- two test tubes in a test tube rack
- biscuit, jam or similar food
- peanut butter or margarine
- filter paper
- dropper

Method

- label the test tubes A and B
- add 2ml of peanut butter or margarine to test tube A
- add 2ml jam or a piece of biscuit to test tube B

- carefully pour 2ml of ethanol into each test tube using(ethanol will dissolve any fat molecules in the samples)
- using the dropper place a small drop of each of the solutions onto a sheet of filter paper
- allow the ethanol to evaporate

Observation

- Hold the paper in front of a window and observe if the sample has left a translucent mark (grease spot).
- If a grease spot is present on the filter paper, then the sample contains lipids

4.Test for proteins

What you need:

- one 10ml syringe or measuring cylinder
- 2 ml cooked beans, raw egg or similar foods
- distilled water
- two test tubes in a test tube rack
- 2ml milk
- biuret reagent
- dropper

Method

- homogenise or mash the beans in some distilled water.
- label the test tubes A and B
- add 2ml of mil to test tube A and 2ml of your other sample to test tube B
- using the dropper carefully add a few drops of biuret reagent to each test tube and swirl the tubes gently to mix the contents

Observation

- observe for any colour change
- biuret reagent changes from blue to pink/purple in the presence of proteins.

5.To investigate the effect of catalase on hydrogen peroxide

Background information:

Catalyse is found in living cells and is used to break down hydrogen peroxide into water and oxygen. Hydrogen peroxide is formed as a by-product of chemical reactions in living cells, particularly in the liver. Accumulation of hydrogen peroxide is toxic to living cells.

What you need:

- two test tubes in a test tube rack
- 10 ml syringe or measuring cylinder
- 2 ml 3% hydrogen peroxide solution (available from pharmacies)
- 2ml water
- fresh chicken liver

Method

- label the test tubes A and B
- using the syringe or measuring cylinder pour 2 ml water into test tube A and 2ml of hydrogen peroxide into test tube B
- carefully place a small piece of chicken liver into each test tube. (The chicken liver should be submerged in the water/hydrogen peroxide)

Observation

- observe the reaction
- write down a hypothesis for this investigation
- explain why to test tubes with different solutions were used
- repeat the experiment using cooked chicken liver
- briefly discuss what you think happened when using the cooked chicken liver.

GRADE 10

Life Science

Strand 1:Life at molecular, cellular and tissue level

Topic: Interpreting information in food packaging

The table below shows some of the nutritional information found on the box of a breakfast cereal. It lists the nutrients in one 40g serving of cereal.

Nutrient	Amount in 40g
Protein	3,g
Carbohydrates	32g
Fat	0,3g
Fibre	1g
Vitamin A	200 ug
Vitamin C	12mg
Vitamin B1 (thiamine	0,3mg
Phosphorus	16mg
Iron	2,8mg
Magnesium	4mg
Potassium	44mg
Sodium	359mg

Table 1.10

Answer the following questions:

1.According to the information on the box, which nutrient is found in the largest amount in this cereal?

2.Briefly why is this nutrient important in the diet?

3.Small amounts of vitamins and minerals are found in the cereal.

Explain why this is so.

4. Use the table on the next page to calculate the percentage of daily vitamins and minerals that a young boy of 15 years would get from a serving of this cereal.

5.Present your results in a table.

Nutrient	Amount in the RDA
Vitamin A	900ug
Vitamin B1	1,2mg
Vitamin C	75mg
Vitamin D	5ug
Vitamin E	15mg
Phosphorus	1 259mg
Calcium	1 300mg
Iron	11mg
Sodium	1,5g
Iodine	150ug
Potassium	4,7g
Magnesium	410mg

Table 1.11

ug – micrograms, one thousandth of a milligram
mg – milligram, one thousandth of a gram
g – gram, one-thousandth of a kilogram

6.It is not necessary to include protein, fat carbohydrate or fibre in your calculation. Some of the nutrients are not included in both of the tables, so it is not necessary to these.

7.Which mineral or vitamin provides nearest to the full amount of the RDA? Which provides the least?

8.Using the information in the first table draw a pie chart to illustrate the nutritional content.

Chapter 2

Life processes in plants and animals

2.1 Support and transport systems in plants[1]

Plant support and transport

[1] This content is available online at <http://cnx.org/content/m41340/1.1/>.

2.1.1 Anatomy of plantsPlants are made up of roots, stems, leaves and flowers. The function of the root is to hold the plant firmly in the ground as well as to absorb water from the soil. The function of the stem is to transport the food made by the leaf to the rest of the plant as well as to hold the plant upright. The main function of the leaves is to photosynthesise (make food).

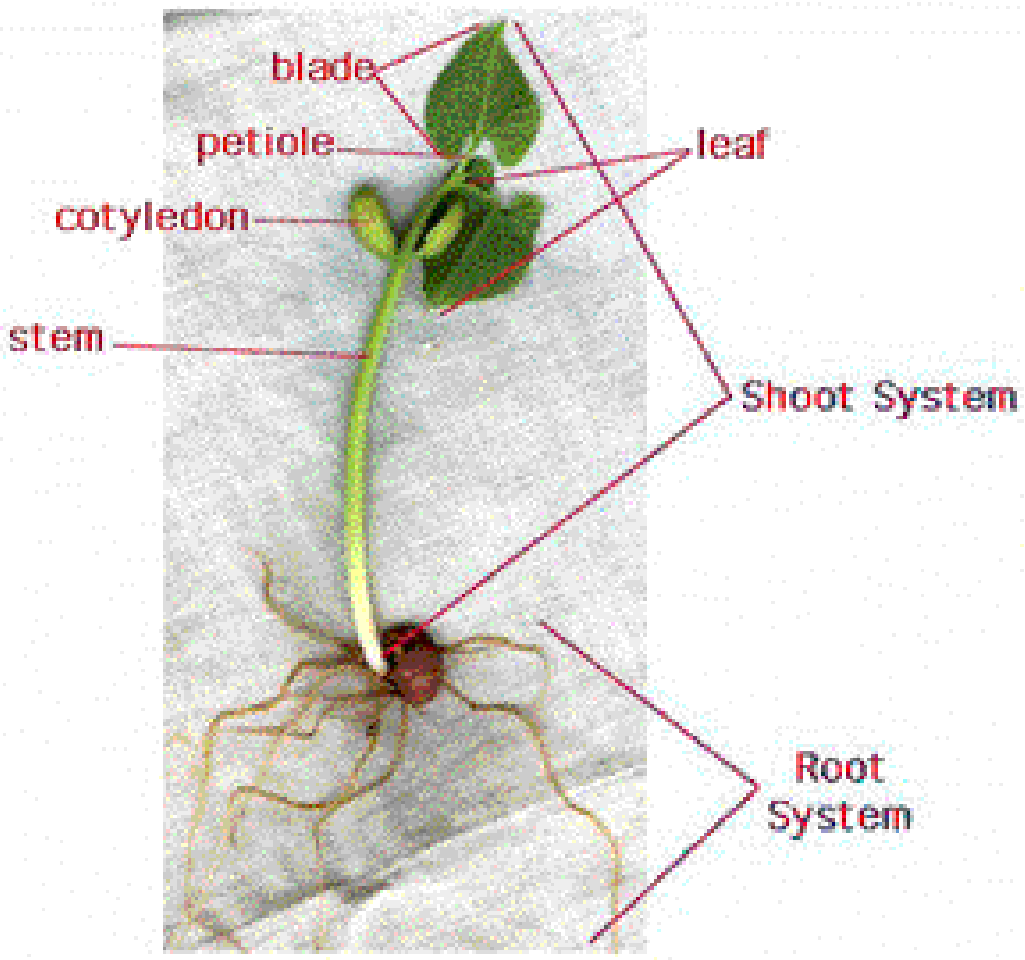


Figure 2.1

2.1.1.1 Differences between monocotyledonous and dicotyledonous

Most plants are stationary which means that they cannot move from place to place. Some plants grow really tall in order to obtain sunlight. They need to stand tall and erect and therefore need to support themselves. They have tissues present in almost all parts of their body e. g. roots, stems, branches, leaves. These supporting tissues keep the stem firm and other parts especially leaves in a favourable for photosynthesis to occur as efficiently as possible

Refer to unit 1 for functions of the different tissues found in roots, stems and leaves

2.1.2 Dicot root

2.1.2.1 External structure of the dicot root

- Root cap protects the tip of the root and it is slimy to facilitate movement through the soil as the root grows.
- Under the root cap is the meristematic region where cells divide continuously by mitosis to produce new cells.
- Cells enlarge in size in the region of elongation. This results in the root growing in length.
- Thousands of tiny root hairs are found in the root hair region. The function of this region is to absorb water and dissolved mineral salts from the soil.
- The root grows wider and may produce lateral roots in the mature region.

2.1.2.2 Internal structure of the dicot root

- No waterproof cuticle in the root as this would hinder the absorption of water.
- The epidermis is a single layer of cells on the outside that protects the inner tissues. Some epidermal cells are specialized to form root hair cells. These absorb water and dissolved mineral salts.
- The cortex consists of parenchyma cells. These cells are large to store water and food. They also facilitate the movement of water from the root hair cells on the outside to the xylem on the inside.
- The endodermis contains Casparian strips that allow the water to enter the stele.
- The stele consists of the:

- Pericycle (responsible for forming lateral roots)
- Xylem (responsible for transporting water and mineral salts to the stem)
- Phloem (responsible for transporting food from the leaves to the roots)

2.1.2.3 Movement of water through the dicot root

This diagram shows the movement of water through the root

- Water is found in the spaces between the soil particles. Water enters through the cell wall and cell membrane of the root hair cell by osmosis. Water fills the vacuole of the root hair cell.
- Water can now move across the parenchyma cells of the cortex in two ways:

- Most of the water passes along the cell walls of the parenchyma cells by diffusion.
- Some of the water passes from the vacuole of one parenchyma cell to the vacuole of the next cell by osmosis.

- The water must pass through the Casparian strips of the endodermis to enter the xylem.
- Once water is in the xylem of the root, it will pass up the xylem of the stem.

Transpiration and movement of water: http://www.phschool.com/science/biology_place/l abbench /lab9/xylem.html

This website shows a diagram of how water moves up through the plant.

http://www.neok12.com/Plants.htm[2]

This video shows plant transport and provides some interactive quiz games.

Investigation: Water uptake by roots

[2] http://www.neok12.com/Plants.htm

2.1.3 Dicot stem

- Leaves develop from the nodes.
- The spaces between the nodes are called internodes.

- An axillary bud is often found at the node. These forms lateral branches.
- A terminal bud is found at the tip of the stem and allows the stem to increase in length.

2.1.3.1 Internal structure of the dicot stem

This diagram of a cross section shows the internal structure of a young dicot stem

- A waterproof cuticle is found on the outside of the epidermis to prevent water loss.
- The epidermis consists of a single layer of cells to protect the underlying tissue.
- The cortex is made up of parenchyma cells that stores water and food.
- The vascular bundles are arranged in a ring in the medulla.
- Each vascular bundle contains the following:

- Pericycle (contains sclerenchyma cells for strengthening and support)
- Cambium (contains meristematic cells that divide to widen the stem)
- Phloem (transports food from leaves to the roots)
- Xylem (transports water from the roots to the stem)

http://bcs.whfreeman.com/thelifewire/content/ch p36/36020.html [3]
This is a link to an online tutorial about phloem, xylem and pressure flow.

2.1.3.2 Movement of water up the stem

- Water moves up the xylem from the roots to the leaves.
- Adaptations of xylem for transporting water:

- Long, elongated tubes joined end-to-end without any cross-walls.
- The cell walls are thickened with lignin for support (annual or spiral thickening).
- Pitted vessels allow for lateral movement of water into neighbouring xylem vessels.

[3] http://bcs.whfreeman.com/thelifewire/content/ch%20p36/36020.html%20

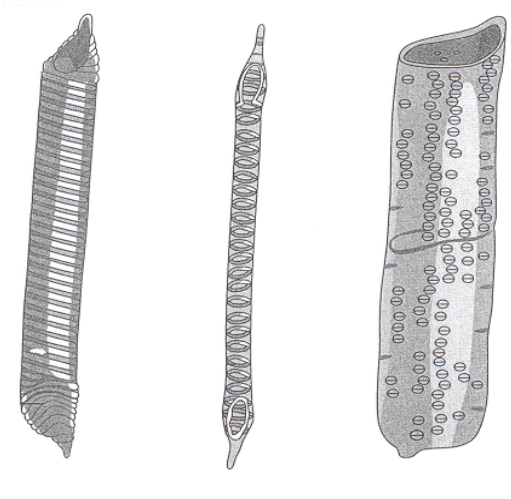


Figure 2.2

Diagram of xylem

- Three forces are responsible for the movement of water up the xylem – capillarity, root pressure and transpiration suction force.
- Capillarity involves forces of cohesion (forces of attraction between water molecules) and adhesion (forces of attraction between water molecules and the sides of the xylem vessels). Because the xylem's lumen (opening) is so tiny, water will move up by capillary.
- Root pressure is a force that pushes water up the xylem. As water enters the root by osmosis, it pushes the water that is already in the xylem of the stem upwards.
- Transpiration suction force is a very important force that pulls water up the xylem of the stem. As water evaporates from the stomata of the leaves during transpiration, it creates a sucking force that will pull the water up the xylem.

Investigation: plant tissue anatomy (root and stem)
Investigation: water uptake by stem

2.1.3.3 Secondary growth

- Every growing season the stem of a plant increases in width – this is known as secondary thickening.
- Towards the end of the first year of growth, the parenchyma cells between the vascular bundles become meristematic and link up with the cambium tissue to form a cambium ring.
- The cells in the cambium ring start dividing to form secondary phloem (on the outside) and secondary xylem (on the inside).
- Each year another ring of secondary phloem and secondary xylem is formed, making the stem grow wider.

http://www.emc.maricopa.edu/faculty/farabee/biobk/biobookplantanat.html[4]
This website provides information on plant structure and support.
Investigation: Tree rings
This diagram shows the process of secondary thickening in stems

[4]http://www.emc.maricopa.edu/faculty/farabee/biobk/biobookplantanat.html

- If you cut through a tree trunk, annual rings are visible.
- The light-coloured rings are called spring wood. They are formed during spring and summer when the growing conditions are favourable. The rings are therefore relatively thick and light in colour as the xylem cell walls are thin.
- The dark-coloured rings are called autumn wood. They are formed during autumn and winter when the growing conditions are unfavourable. The rings are therefore relatively thin and dark in colour as the xylem cell walls are thick.
- By counting either the light rings or dark rings, you can determine the age of the tree.

This diagrams shows the annual rings of a tree trunk

2.1.4 Dicot leaf

2.1.4.1 Internal structure of the dicot leaf

Refer to chapter 1 to remind yourselves of the internal structure of a dicot leaf.

This diagram shows the movement of water through a dicot leaf .

2.1.4.2 Transpiration

Transpiration is the evaporation of water from the leaves of plants. Water is lost from the leaf through special pores called stomata. Stomata are found on both surfaces of the leaf but there are usually more on the ventral (lower surface) of the leaf. This is to reduce the amount of transpiration that will occur because the top of the leaf is exposed to more sunlight than the bottom.

- http://education.uoit.ca/lordec/ID_LORDEC/transpiration_pull/[5]

This interactive website explains transpiration pull. Plants use the process of transpiration pull to move water from the soil up into the leaves.

- Water moves from the xylem of the stem to the xylem of the leaves. The xylem is found in the veins of the leaf.
- Water diffuses from the xylem of the leaf into surrounding mesophyll cells.
- Water circulates amongst the cells of the leaf to supply them with their water requirements.
- Excess water diffuses into the sub-stomatal air spaces.
- Heat from the environment causes the water in the sub-stomatal air spaces to evaporate out of the stomata. This process is called transpiration.
- Transpiration is therefore defined as the loss of water vapour from the leaves of a plant.
- Transpiration only occurs during the day when the stomata are open. At night the stomata are closed.

2.1.4.2.1 Rate of transpiration

This increases in conditions of ...

- High light intensity (bright sunlight)
- Increased temperatures (hot weather)
- Wind
- Low humidity (dry conditions)
- Soil water

[5] http://education.uoit.ca/lordec/ID_LORDEC/transpiration_pull/

LightPlants transpire more rapidly in the light than in the dark. This is largely because light stimulates the opening of the stomata. Light also speeds up transpiration by warming the leaf.

Temperature Plants transpire more rapidly at higher temperatures because water evaporates more rapidly as the temperature rises. At 30 °C, a leaf may transpire three times as fast as it does at 20 °C.

WindWhen there is no breeze, the air surrounding a leaf becomes increasingly humid thus reducing the rate of transpiration. When a breeze is present, the humid air is carried away and replaced by drier air. So a steep diffusion gradient is maintained.

HumidityThe rate of diffusion of any substance increases as the difference in concentration of the substances in the two regions increases. When the surrounding air is dry, diffusion of water out of the leaf goes on more rapidly.

Soil waterA plant cannot continue to transpire rapidly if its water loss is not made up by replacement from the soil. When absorption of water by the roots fails to keep up with the rate of transpiration, loss of turgor[6] occurs, and the stomata close. This immediately reduces the rate of transpiration (as well as of photosynthesis). If the loss of turgor extends to the rest of the leaf and stem, the plant wilts.

The volume of water lost in transpiration can be very high. It has been estimated that over the growing season, one acre of corn (maize) plants may transpire 1.5 million litres of water. As liquid water, this would cover the field with a lake 38 cm deep. An acre of forest probably does even better.

The diagram below shows a potometer which is used to measure the rate of transpiration. As the leafy twig transpires, the air bubble moves to the left. The quicker the air bubble moves the faster the leafy twig is transpiring.

Diagram of a potometer

Investigation: transpiration rate

The diagram below shows a summary of the movement of water from the roots to the leaf.

2.1.5 Why do plants need water?

Plants need water to maintain turgor pressure. This helps provide support for the plant and when a cell absorbs water the cell membrane pushes against the cell wall. The cell is now turgid. If there isn't enough water in the plant the membrane moves away from the cell wall and the cell is now flaccid. This is when a plant begins to wilt and will eventually die.

When the environment is extremely humid (moist) the rate of transpiration is very low. Leaves secrete water onto the surface of the leaves through specialised pores called hydathodes. So drops of water found on plants in the morning is usually the result of guttation not dew.

2.1.6 Movement of manufactured food

Plants use carbon dioxide and water to manufacture glucose and oxygen is the waste product. Sunlight and enzymes are necessary for photosynthesis to occur. Once the food is manufactured in the leaves it needs to be distributed to the entire plant so that the glucose can be used by each cell for respiration (manufacture energy).

Sunlight and enzymes

water + carbon dioxide ——————[U+F0E0] glucose (carbohydrates) + oxygen

[U+F0DF]——————

The glucose is manufactured mainly in the palisade cells and then passes into the phloem. Transport of food material from leaves to other parts of the plant is called translocation. This food may be stored in roots, stems or fruit.

Read more: Anatomy of Plants - Biology Encyclopedia - cells, body, function, system, different, organs, hormone, structure, types, membrane[7] http://www.biologyreference.com/A-Ar/Anatomy-of-Plants.html#ixzz1an9JO8yK[8]

[6] http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/G/GasExchange.html#leaves

[7] http://www.biologyreference.com/A-Ar/Anatomy-of-Plants.html#ixzz1an9JO8yK

[8] http://www.biologyreference.com/A-Ar/Anatomy-of-Plants.html#ixzz1an9JO8yK

Phloem tissue is made up of two different types of cells which are sieve tubes and companion cells. Sieve tubes are the main conducting cells. These cells look like a sieve and phloem sap moves from cell to cell though the phloem walls. Unlike cells of the xylem, sieve tubes are alive at functional maturity, but do not have nuclei. Companion cells have nuclei and are closely associated with sieve tubes. Companion cells support the sieve tubes . The cytoplasm of sieve tubes and companion cells is connected through numerous pores called plasmodesmata. These pores allow the companion cells to regulate the content and activity of the sieve tube cytoplasm. The companion cells also help load the sieve tube with sugar and the other metabolic products that they transport throughout the plant.

2.2 Unit 2.1 Investigation 1 - Anatomy of plant tissue[9]

2.2.1 Investigation – Looking at plant tissues under the light microscope

2.2.1.1 Materials required

- Scalpel or knife
- Celery stalk (stem)
- Carrot (root)
- Glass slide
- Iodine solution (Stain) or water
- Cover slip
- Dissecting needle or tweezers
- Paper and pencil

2.2.1.2 Method

1. Cut a very thin slice (cross section) from the middle of the celery stem or the carrot root.
2. Place this section on a glass slide.
3. Cover the specimen with iodine solution in order to stain it. This makes it more visible under the microscope. The specimen can also be placed on a drop of water if iodine is not available.
4. Cover the specimen by carefully lowering the cover slip onto it with a dissecting needle or tweezers. Take care not to trap any air bubbles.

This link gives information about making a wet mount microscope slide and shows an instructional video.
http://www.microbehunter.com/2010/08/13/making-a-wet-mount-microscope-slide/
Call your teacher.

1. Switch on the microscope making sure the lowest objective is in position (the 4x objective).
2. Place your slide on the stage.
3. Focus the image under the 4x objective (lowest objective) and view the structure of the celery stem. Switch to the 10x objective to look a little more closely. To see amazing details of the structure of plant tissue, use the 40x objective and the slide, carefully observing all of the parts and different cells.
4. Once you are able to see cells,

Call your teacher.

1. Make a biological drawing of your specimen as viewed under the microscope. Take note of the magnification and draw a scale bar. Label your diagram according to the tissues you have learnt about.

[9] This content is available online at <http://cnx.org/content/m41332/1.1/>.

2.2.1.3 Variation:

Be creative and try using your favourite vegetables! Which vegetables are roots, stems and leaves?

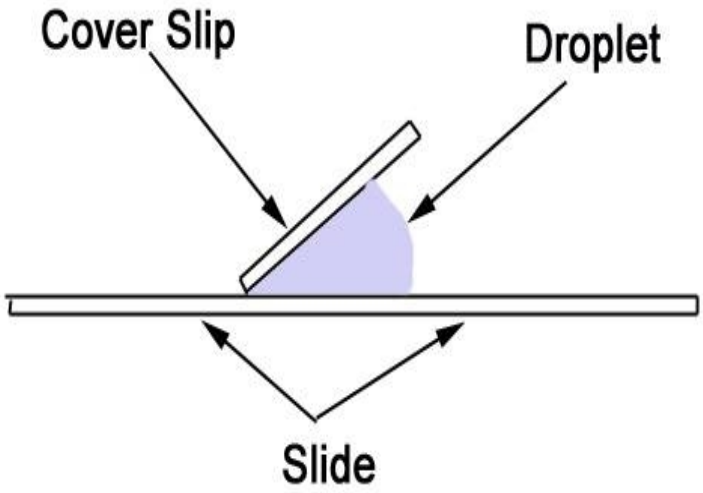


Figure 2.3

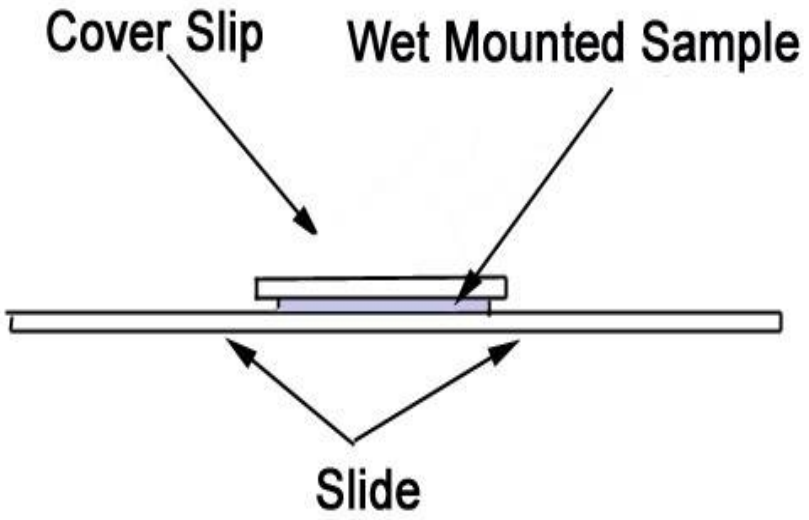


Figure 2.4

Place the sample in the centre of the slide. Add a drop of iodine or water on top of the sample. Place the cover slip next to the droplet as shown in the diagram.

Lower the coverslip into place with tweezers. As you lower the coverslip downwards, the drop will spread outward and suspend the sample between the slide and the coverslip.

(Diagrams from http://www.ehow.com/how_5164819_prepare-wet-mount-slide.html)

2.3 Unit 2.1 Investigation 3 - Water uptake by the stem[10]

2.3.1 Investigation – Water movement through the xylem

2.3.1.1 Materials

Water

Food colouring dye (available at supermarket)

White flower on a stem, e.g. Impatients, carnation or chrysanthemumScissors Two jars, cups or measuring cylindersPlastic tray Sticky tape

2.3.1.2 Method

Before starting this experiment, try to guess how the dye might move up the stem into the flower.

[10] This content is available online at <http://cnx.org/content/m41331/1.1/>.

1. Fill one jar with plain water, and one with water containing several drops of food colouring dye.
2. Take the flower and carefully cut the stem lengthwise, either part way up the stem or right up to the base of the flower (try both – the results will be different!)

1. Put one half of the stem into the jar containing plain water and one half of the stem into the jar containing food colouring dye. To make it easier to insert the stalks without breaking them, it helps to wedge paper underneath the jars so that you can tilt them towards each other. Tape the jars or cylinders down onto a tray so that they do not fall over.
2. Observe the flowers after a few hours and the next day, and note where the dye ends up in the flowerhead. You can leave the flowers up to a week but be sure to make sure that they have enough water.

Variation: Instead of using one cylinder with water and one with food dye, use two different colour food dyes (e.g. blue and red). At first the flower will show two separate colours, but as time goes by the whole flower will show both dyes. This is because water can move sideways between xylem vessels through openings along their length. The ability of water to move sideways between vessels is useful for when air becomes trapped in a vessel, causing a blockage. If you cut the stem right up to the base of the flower, this will limit movement between the xylem vessels.

Variation: Try using celery stalks with leaves. Cut open the celery stalk (cross-section) and you will see that the little holes inside are coloured – these are the vessels.

An example of this experiment with photographs can be found at: http://www.practicalbiology.org/areas/intermediate/cells-to-systems/transport-in-plants/investigating-transport-systems-in-a-flowering-plant,70,EXP.html[11]

2.4 Unit 2.1 Investigation 5 - Transpiration rate[12]

2.4.1 Investigation – the effect of environmental conditions on transpiration rate (using a simple potometer)

A potometer measures the rate of transpiration by measuring the movement of water into a plant. The following experiment uses a simple hand made potometer to assess the effect of different environmental conditions (e.g. temperature) on transpiration rate.

2.4.1.1 Apparatus

le{ïĆů}intopreamble] a drinking straw
le{ïĆů}intopreamble] a soft green leafy shoot
le{ïĆů}intopreamble] Vaseline
le{ïĆů}intopreamble] Marking pen
le{ïĆů}intopreamble] Play dough / putti
le{ïĆů}intopreamble] Plastic bag
le{ïĆů}intopreamble] Elastic band
le{ïĆů}intopreamble] Ruler

[11] http://www.practicalbiology.org/areas/intermediate/cells-to-systems/transport-in-plants/investigating-transport-systems-in-a-flowering-plant,70,EXP.html

[12] This content is available online at <http://cnx.org/content/m41328/1.1/>.

2.4.1.2 Method

2.4.1.2.1 Perform the following steps under water

1. Cut the stem of the leafy shoot under water.
2. Test to make sure the stem of the leafy twig will fit snug tightly into the top of the straw.
3. Remove the leafy shoot from the straw and set aside.
4. Fill the straw with water. Place your finger over one end of the straw to stop the water from running out.
5. Put the leafy shoot into the open end and seal it with play dough while removing it from water (KEEP FINGER ON THE STRAW!)

2.4.1.2.2 Perform the following steps above water

1. Seal with Vaseline. Make sure it is air tight and water tight – if not, all the water will run out when you take your finger off the straw.
2. Mark the water level on the straw.
3. Place your photometer under one of the following conditions for one hour:
    a. as is, in a warm, sunny place (no wind)
    b. as is, in a warm, windy place
    c. with a plastic bag tied around the leaf, in a warm, sunny place.
    d. A shady place
4. After an hour: use the marking pen to mark the change in water level on the straw.
5. Measure the distance the water moves.

2.4.1.3 Results

1. Draw a table and record the class' results.
2. Plot a bar graph to compare the distances the water moved in the different straws.

2.4.1.4 Discussion

1. Why is it important to cut the stem under water?
2. What does the water movement in the straw indicate?
3. Which four external environmental factors are you investigating?
4. Under which condition is water loss from the leaf the greatest?

2.4.1.5 Conclusion

1. What can you conclude from this investigation?
2. Give two ways in which you can improve your experimental results.

More information about potometer experiments can be found on the following websites:
http://www.practicalbiology.org/areas/advanced/exchange-of-materials/transpiration-in-plants/measuring-rate-of-water-uptake-by-a-plant-shoot-using-a-potometer,62,EXP.html[13]
http://www.practicalbiology.org/areas/advanced/exchange-of-materials/transpiration-in-plants/[14]

[13] http://www.practicalbiology.org/areas/advanced/exchange-of-materials/transpiration-in-plants/measuring-rate-of-water-uptake-by-a-plant-shoot-using-a-potometer,62,EXP.html
[14] http://www.practicalbiology.org/areas/advanced/exchange-of-materials/transpiration-in-plants/

2.5 Unit 2.2 Investigation 1 - Tree rings[15]

2.5.1 Investigation - Observing annual rings in a cut tree to assess age and climatic conditions

Every year a tree forms a new layer of xylem around the trunk. This forms tree rings, which are visible as circles in a cross section of a tree that has been cut down. Each tree ring, or wood layer, consists of two colours of wood; light wood that grows in spring and summer and dark wood that grows in autumn and winter. Tree rings can be counted to give you a rough estimation of the age of a tree. Occasionally a tree will form many rings in one year or miss forming rings in a year. In order to get an accurate estimation of the age of a tree it is better to look at trees with at least 30 rings. The width of tree rings is greater in years where good growing conditions occur. In years with droughts or low temperatures, the trees will produce smaller rings. Therefore, by looking at the tree rings you can get an idea of the weather affecting a tree in a particular year. Scientists can use this information to help determine the weather patterns of the past as well as events such as forest fires, earthquakes and volcanic eruptions. The study of past events using the growth rings of trees is known as dendrochronology ("dendros" = tree, "chronos" = time).

1. Find a cut or fallen tree, and count the tree rings, starting with the innermost ring. Measure the width of each ring using a ruler, or make a note of whether a ring is narrow or wide. Make a note of any scars caused by events such as fires or pests.

1. Draw a bar graph showing the width of your tree rings for every year of the tree's life.
2. How old is your tree? What can you say about the climatic conditions throughout the life of your tree?

http://www.classzone.com/books/earth_science/terc/content/investigations/es2905/es2905page01.cfm[16]
This is a link to an online tutorial about counting tree rings.
http://www.arborday.org/kids/carly/lifeofatree/[17]
This is a link to a great cartoon video about the different tissue layers in trees (xylem, phloem, etc) and the formation of tree rings.

2.6 Skeletons[18]

2.6.1 SESSION 3: Structure, support and movement in animals AND INSECTS Part 1

2.6.1.1 Key Concepts

In this session we will focus on summarising what you need to know about:

- Types of Skeletons
  - Hydrostatic skeleton
  - Exoskeleton
  - Endoskeleton
- The Human Skeleton
  - Types of Bones
  - Tissue of the Skeleton
  - Structure of Skeleton

Explanation

[15] This content is available online at <http://cnx.org/content/m41333/1.1/>.
[16] http://www.classzone.com/books/earth_science/terc/content/investigations/es2905/es2905page01.cfm
[17] http://www.arborday.org/kids/carly/lifeofatree/
[18] This content is available online at <http://cnx.org/content/m41337/1.1/>.

2.6.1.1.1 Overview

- Plants have an internal skeleton that consists of strengthening tissue xylem and sclerenchyma.
- Animals are able to move from one point to another to look for food, shelter and mates.
- The simplest invertebrates have specialised cells and tissues to assist them to move to and from stimuli.
- Structure and support in the body is important for movement.

2.6.1.1.2

Hydrostatic skeleton

- The fluid skeleton fills a cavity in the centre of the animal called the coelom
- Enclosed by the muscles of the body wall
- The fluid presses against the muscles, that contract against the pressure of the fluid
- So, a combination of the pressure of the fluid and the contracting muscles, maintains the shape of the animal and allows for movement
- If the body is segmented the pressure of the fluid is localised in a few segments at a time.

Advantages:

- not rigid
- allow the animal to move in a more flexible manner
- fluid cavity stimulates circulation in the animal

Disadvantages:

- dehydration will affect the skeleton directly and the ability of the animal to move because of the loss of shape
- does NOT provide protection for the internal organs

2.6.1.1.3

Exoskeleton

- This is a hard outer shell – e.g.: insects
- The skeleton is made of a substance called chitin, secreted by the epidermis
- The head and thorax make up the exoskeleton
- The abdomen is soft and attached to the thorax
- The exoskeleton acts as a hard outer covering to animals and is made up of a series of plates or tubes.

Advantages:

- forms the point of attachment of internal muscles needed for locomotion and flight
- supports and protects the delicate inner parts of the animal
- prevents desiccation (drying out) on land
- has a low density and is therefore lightweight, to allow for flight

Disadvantages:

- final body size is limited because as the body size increases, the surface area to volume ratio decreases
- growth is restricted, so periodic moulting is required if the animal is to grow
- very vulnerable when it is in the moulting process, as it cannot move until the exoskeleton is dry

2.6.1.1.4

Endoskeleton

This skeleton is found inside the body and can consist of bone (vertebrates) or cartilage (sharks).
Advantages:

- Endoskeletons consist of living tissue - so it is able to grow steadily within the animal
- the skeleton is jointed which allows for movement and support
- muscles attach directly to the skeletal bones to allow for movement and support
- vital organs are protected by bone cavities like the ribcage and the pelvic girdle

Disadvantages:

- Lack of mineral elements like calcium and phosphates will cause brittle bones and affect movement and support

. Lack of vitamin D in the diet results in a condition/disease caused rickets. A disease characterised by bowed legs.

Figure: Human Skeleton

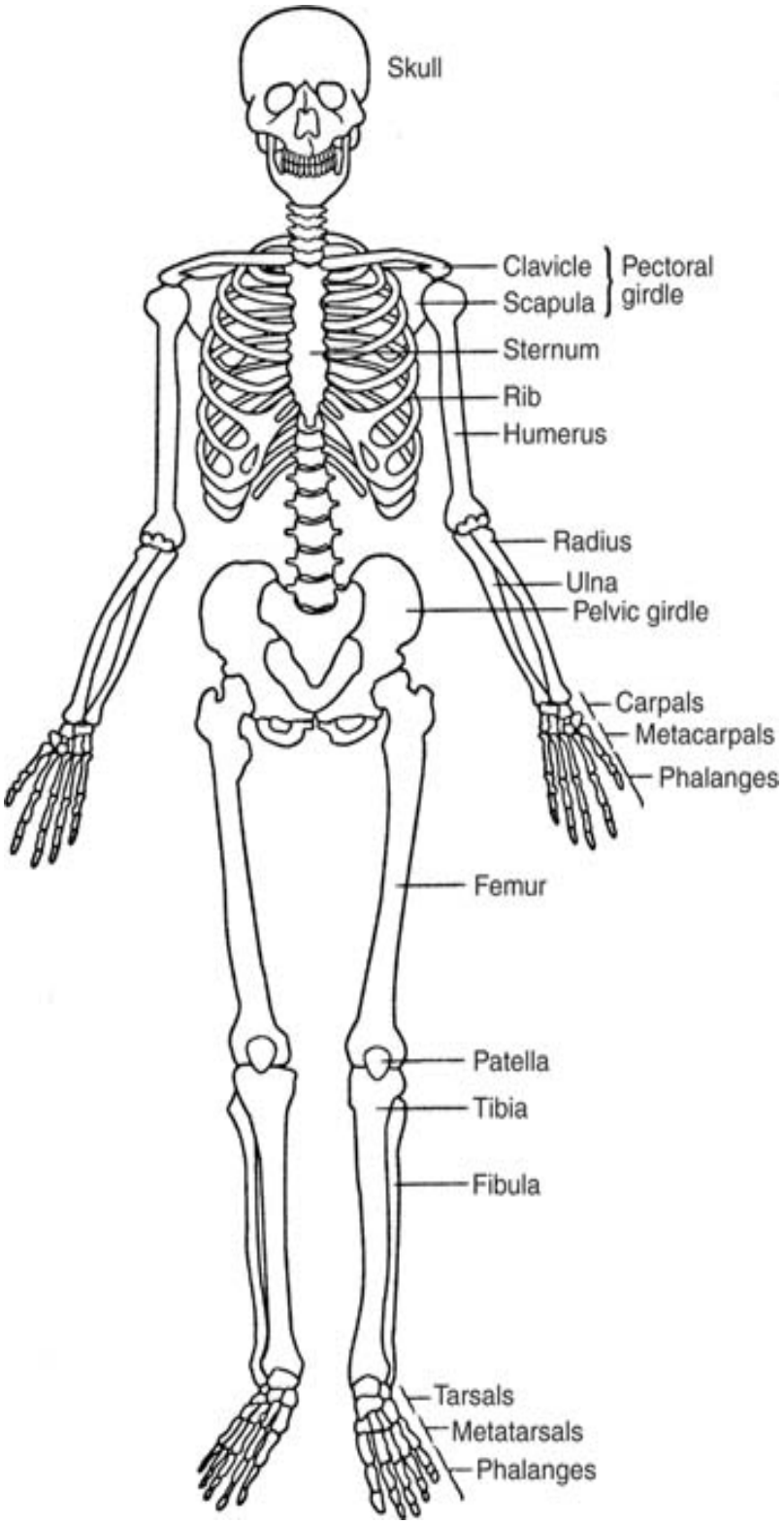

Skull
Clavicle
Scapula
Pectoral girdle
Sternum
Rib
Humerus
Radius
Ulna
Pelvic girdle
Carpals
Metacarpals
Phalanges
Femur
Patella
Tibia
Fibula
Tarsals
Metatarsals
Phalanges

Figure 2.5

Available: http://www.cliffsnotes.com/WileyCDA/CliffsReviewTopic/Skeletons-in-Animals.topicArticleId-8741,articleId-8716.html

2.6.1.2 Overview:

- •• Humans have an internal skeleton made of bone, cartilage and connective tissue.
- •• Functions of the human skeleton:

- •o provides body shape and support
- •o protects vital organs (skull=brain, ribcage=heart and lungs and pelvic bones=digestive tract and reproductive organs)
- •o allows body to move because muscles attach to the bones to give them leverage
- •o long bones contain red bone marrow to produce red blood cells
- •o bones store minerals such as calcium and phosphate ions
- •o bones in the middle ear, called the hammer, anvil and stirrup, amplify sound waves and assist in the hearing process

Types of bones

- •• Long bones have a central shaft and two heads, one at each end. An example is the femur, which is the largest bone in the body.

- •• Flat bones have two layers of compact bone covering a layer of spongy bone on the inside, for example the shoulder blades.

- •• Irregular bones and short bones have a thin layer of compact bone covering spongy bone on the inside, for example vertebrae of the spine and the small bones in the hands and feet.

Tissue of the Skeleton

- •• Bone Tissue
- •• Cartillage

Structure of Human Skeleton

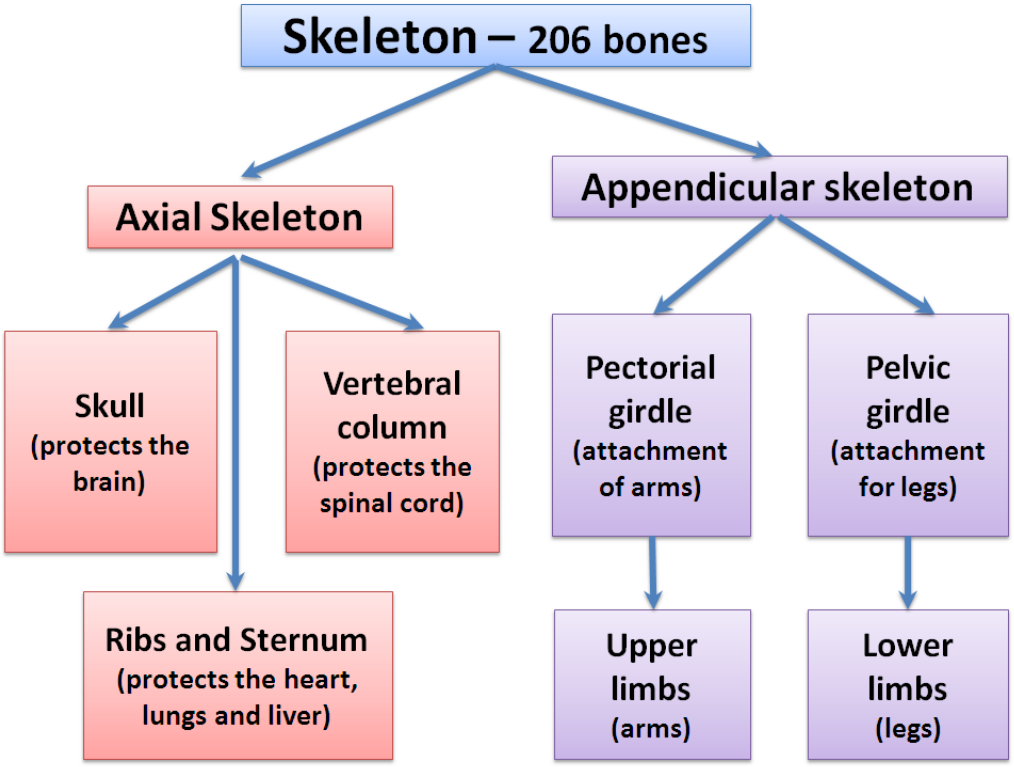


Figure 2.6

2.7 Human Locomotion and Muscles[19]

2.7.1 Unit 2.2 Support systems in animals

Human locomotion Muscles Muscle Exercise: Classifying Muscle Types Interesting facts – Skeleton

2.7.2 Human locomotion

Definition 2.1: Locomotion
Movement or the ability to move from one place to another.

Definition 2.2: Human locomotion
the ability you have to move from one place to another (walking from your house to a friend's)

2.7.2.1 What is used during locomotion?

2.7.2.1.1 Bones = body's supporting structure

- provide the framework

[19] This content is available online at <http://cnx.org/content/m41358/1.1/>.

- provide internal core structure for the attachment of muscles.
- Protection of human organs
- Keeps body shape

2.7.2.1.2 Joints = place in your body where two bones are connected

2.7.2.1.2.1 Three type of joints

Fibrous joints. Synovial joints

2.7.2.1.2.2 1) Fibrous joints

- join bones where no movement is allowed
- for example the bones of the cranium.

2) Cartilaginous joints allows slight, restricted movement for example the discs between the vertebrae of the spine

2.7.2.1.2.3 3) Synovial joints

- Allow free movement in one or more directions to the joints of the pelvic and pectoral girdles.
- These joints facilitate movements like standing, sitting, walking and running.

2.7.2.1.3 Ligaments = connect bone and bone.

- Hold bone in place so that they work in a coordinated manner.
-

2.7.2.1.4 Tendons = connect muscles to bone.

- Attachment to the skeletal muscles move your bones
- Facilitate the various positions of the body related to movement and balance.

2.7.2.1.5 Antagonistic muscles

- Antagonistic = 'opposite'

Antagonistic movement of muscles

- at least two sets of muscles
- one set contracts and the other relaxes

- Contraction = stimulated muscle – becomes shorter and thicker
- Relaxation = muscle relaxes

2.7.2.1.5.1 Example: your biceps and triceps

- The biceps is an example of a flexor muscle (muscle whose contraction shortens a body part)
- Whereas the triceps is an example of an extensor muscle (muscle whose contraction extends or stretches a body part).

Figure 2.2.1: Illustration of the triceps (extensor muscle) and biceps muscles (flexor muscle). Found in http://commons.wikimedia.org/wiki/File:Anatomy_and_physiology_of_animals_Antagonistic_muscles,_flexion%26tensio

Video illustrating the mechanics of the antagonism within the biceps and triceps.
http://www.youtube.com/watch?v=T-ozRNVhGVg&feature=related[21]

2.7.3 Muscles

2.7.3.1 <definition><term> Definition: </term><meaning>= Muscle is a contractile[22] tissue[23] type of animals</meaning></definition>

Three types of muscle

2.7.3.2

Three types of muscle

2.7.3.3 Three types of muscle

1) Smooth/ involuntary

- not by will- spontaneous
- unconscious routine tasks of the body
  - Food moving down the digestive system
  - keeping the eyes in focus
  - adjusting the diameter of blood vessels

2.7.3.3.1 Structure of smooth muscle

- spindle shaped cells with nucleus

IMAGE Details on wish list
Figure 2.2.1: Illustrates the structure of a smooth muscle

2.7.3.3.2 Functions:

Found in the walls of:

- blood vessels
- Uterus
- bladder
- Intestines

[20] https://webmail.sun.ac.za/owa/redir.aspx?C=458683a32cd84d20a8a5aee95b5173ca&URL=http%3A%2F%2Fcommons.wikimedia.org%2Fwiki%
[21] http://www.youtube.com/watch?v=T-ozRNVhGVg&feature=related
[22] http://en.wikipedia.org/wiki/Muscle_contraction
[23] http://en.wikipedia.org/wiki/Tissue_%28biology%29

2.7.3.3.3 Cardiac muscle

- Responsible for your heart beat (muscle only found in the heart)
- Only found in the walls of the heart
- Structure
  - branched and contains intercalated disks
  - Carry message in each cell for heart contraction

IMAGE! Details on wish list

Figure 2.2.2: Illustrates the structure of the cardiac muscle

2.7.3.3.4 Voluntary/skeletal

controlled by will

- running
- Walking
- Skipping

2.7.3.3.4.1 Structure of voluntary muscle

- The basic units of a muscle are called the myofibrils.
- These myofibrils make up the muscle fibre (large muscle cells).

- Numerous of muscle fibres (cells) are found in bundles.
- These bundles are surrounded by perimisium
  - This is called fasciculus

Numerous fasciculi are surrounded by epimysium

- This forms a muscle

- IMAGE! Details on wish list

Figure 2.2.3: Indicates the differing structural components of the voluntary muscle.

2.7.3.3.4.2 How muscle contracts?

- Myofibrils are responsible for the muscle contraction.
- Each myofibril consists of units called sacromeres (there are many sacromeres in each myofibril)
- Sacromeres consist of thin actin[24] filament and thick myosin[25] filaments.
  - When muscle fibres contract these filaments slide across each other.
    - The actin filaments shorten, but the length of the myosin filaments do not change.
  - This causes the sacromeres shorten
    - Leading to the whole muscle to shorten
- ATP (energy) is a substance in the muscle fibre that provides energy for the contracting actin filament.

IMAGE!!!Details on wish list

Video: Summary of the workings of the muscle http://www.khanacademy.org/video/anatomy-of-a-muscle-cell?playlist=Biology

[24] http://en.wikipedia.org/wiki/Actin
[25] http://en.wikipedia.org/wiki/Myosin

2.7.4 <exercise>Muscle Exercise: <problem>

Choose the correct answer for column A from column B (only one correct answer per question)

Column A	Column B
A) Attached to skeleton by tendons	1) Cardiac muscle
B) Seen in bundles	2) Blood vesels
C) They make up muscle fibers	3) Muscles
D) Spindle shaped structure	4) movement
E) Causes the pumping action of the heart.	5) muscle fibres
F) smooth muscles are found here	6) Fasciculus
G) spesialised tissue	7) myofibrils
H) contraction and relaxation	8) voluntary muscles
I) bundles surrounded by perimysium	9) epimysium
J) Numerous fasciculi are surrounded by	10) Involuntary muscle

Table 2.1

</problem></exercise>

2.7.5 <exercise> Classifying Muscle Types <problem>

Use the following story to classify the different muscle types. Use a coloured pen or highlighter to classify the following and then draw each structure:

Pink = Cardiac Muslces; Blue =Voluntary ; Yellow = Involuntary

BEEP BEEP BEEP!!!6 a.m on a Monday morning Tsholo's alarm goes off. She jumps out of bed and walks to the toilet to relieve her bladder. Tsholo is very excited for the day and skips back to her room to get dressed and pack her school bag for the new week. In the kitchen mom has prepared Tsholo's favourite porridge –Mielie Meal *. Tsholo eats het porridge with great pleasure. After breakfast, she brushes het teeth and skips to the car where she waits for mom to unlock the doors.

At school Tsholo runs to her friends in total excitement to tell them about her visit to her grandmother. While chatting she sees Tom - the boy she likes a lot! He looks her way and Tsholo's starts blushing. Her heart rate increases and her palms become sweaty.

The bell rings. Tsholo and her friends walk to class, giggling and talking. Her heart rate slowly returns back to normal .

The week has begun...

Draw and label the three different muscle types

Cardiac:

Voluntary:

Involuntary:

</problem></exercise>

2.7.6 <note>Interesting facts – Skeleton

1. A baby is born with more bones (360 bones) than an adult (average 206 bones). Bones making up the skull and the spine fuse together as the body grows making it less.
2. The femur/thigh bone is the largest in your body. The femur is approximately one quarter of a person's overall height.

3. Strengthen your skeleton by drinking milk and eating other dairy products (such as cheese and yogurt). They contain calcium which keeps bones healthy and strong.
4. A broken bone produces many new cells to rebuild the bone. These cells cover both ends of the broken part of the bone and close up the break.
5. Your bones are alive! In your body bones have their own nerves and blood vessels.
6. Your bone is 50% water and 50% solid material
7. You have 14 bones are in your face.
8. There are 8 bones in each of your wrists
9. You have 23 bones in each foot (this includes the ankle)

2.7.6.1

Your skull is made up of fused bones which acts like a hard protective helmet for your brain.

2.8 Dissection of Heart[26]

GRADE 10 DISSECTION OF HEART

Practical investigation of sheep's heart

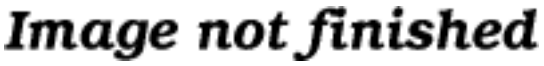


Figure 2.7

Equipment:

• 1 sheep heart • Cutting board • Scalpel • textbook	• Cotton • water • funnel • __53scissors

Table 2.2

TOTAL

1.EXTERNAL

(a)How would you describe the general shape of the heart?(1)

_____

(b)Note the grooves on the surface of the heart. In which direction do they run.
What do you observe in these grooves.

_____(3)

(c)Identify the atria and ventricles. How do they differ from each other in
appearance. What difference do you notice between the atria and ventricles.

_____
_____

[26]This content is available online at <http://cnx.org/content/m41376/1.1/>.

_____(4)

2.If the venae cavae are sufficiently long, insert a funnel into the superior vena cava and tie off the inferior vena cava with a piece of cotton. When water is added through the superior vena cave into the right atrium:

(a)What happens to the wall of the right ventricle?

_____(1)

(b)Press the right ventricle. What do you observe?

_____(2)

(c)Release the pressure. What happens?

_____(2)

(d)Now press the left ventricle a few times. What do you notice?

_____
_____(2)

(e)Now attach funnel to one of the pulmonary veins and tie off the others (if possible). Pour water down the funnel and press the left ventricle. What do you observe?

_____
_____(2)

(f)Release the pressure and press the right ventricle. What do you observe?

_____(2)

Remove the funnel and tubes.

3.Cut the superior vena cava from the atrium and cut open the wall of the atrium. Do the same with the pulmonary vein and left atrium.

(a)Describe the appearance of the inner atrial surface.

_____(2)

(b)Determine the position of the pulmonary artery and the aorta by inserting a glass rod through these vessel into the chambers of the heart.

Name the artery that leaves the right ventricle. _____(1)

Name the artery that leaves the left ventricle. _____(1)

4.Make an incision in the right side of the left ventricle from the oblique groove to the apex of the heart.

(a)What do you observe between the left atrium and left ventricle?

_____(2)

(b)How many flaps do you see? _____(2)

(c)What is the function of these flaps? _____

_____(2)

5.Similarly, make an incision in the left wall of the right ventricle from the oblique groove.

(a)How many flaps do you see between the atrium and the ventricle?

_____(2)

(b)What do these flaps collectively form? _____(2)

6.Compare the muscular walls of the:

(a)atria and the ventricles _____

_____(2)

(b)left and right ventricles _____

_____(2)

7.What do you observe between the two halves of the heart.

_____
_____(2)

8.Examine the tendinous cords.

(a)Where are their points of attachment? _____

_____(2)
(b)What is their function? _____
_____(2)
9. If the pulmonary artery and aorta are long enough, do this question. Using a funnel, pour water into the pulmonary artery and the aorta.
(a)What do you notice? _____
_____(2)
(b)What do you see at the base of these arteries? _____
_____(2)
10. Cut the aorta and pulmonary arteries open longitudinally and examine the valves.
(a)How many parts are there to each of these valves? _____
_____(2)
(b)Compare the walls of the aorta and the pulmonary artery and suggest a reason for any difference you many find.
_____
_____
_____(4)

2.9 Blood Health Prac[27]

GRADE 11PRAC 1 HEART HEALTH TOT: 30NAME:

Part One: Investigating your cardiovascular fitness

Aim:To investigate your heart rate before, during and after strenuous aerobic exercise.

Methods:

1. Work in pairs on the field and ensure you have a stop watch.
2. One partner performs the experiment and the other records the results. Partners then swap roles.
3. Take the resting pulse rate before exercising.
4. One partner runs quickly around the field twice.
5. Immediately after the run take his pulse.
6. Continue to take his pulse every minute for 5 minutes.
7. Record the results and plot a graph using the data pertaining to you.

How to take a pulse: Count the number of beats in exactly 30 seconds. Then times this by 2 to find the pulse rate per minute,

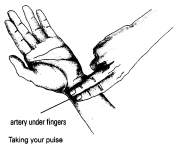


Figure 2.8

Results:

[27] This content is available online at <http://cnx.org/content/m41374/1.1/>.

TIME	HEART RATE (BEATS PER MINUTE)
Before exercise (resting)	
0 min (immediately after exercise)	
1 min (after exercise)	
2 min	
3 min	
4 min	
5 min	

Table 2.3

Draw a line graph to illustrate your results on the following axis (show the resting pulse rate as a separate dotted line on the axis).

(10)

Mark allocation: heading [U+F0FC][U+F0FC]x-axis scale [U+F0FC]x-axis label [U+F0FC]
y-axis scale [U+F0FC]y-axis label [U+F0FC]plotting graph [U+F0FC][U+F0FC][U+F0FC]
neat and done in pencil [U+F0FC]

Questions:

1.Write a hypothesis for this investigation.

_____
_____
(2)

2.Write down the independent variable.

_____(1)

3.Write down the dependent variable.

_____(1)

4.Name ONE factor that must be kept constant during this investigation.

_____(1)

5.Write down TWO ways in which the accuracy of this investigation can be improved.

_____
_____
(2)

6.What conclusions can be made about your cardiovascular fitness?

_____
_____
_____
_____
(4)

7.Explain why the heart rate increases during exercise?

_____
_____
_____
(4)

Part Two: Investigating your family's heart health

Instructions:

1. Draw up a table to record the answers to the following yes/no questions:

i. Do you smoke?
ii. Are you overweight?
iii. Do you exercise regularly?
iv. Do you follow a healthy diet (low fat, low salt)
v. Do you have your blood pressure checked regularly?
vi. Do you have a family history of heart and circulatory disease?

1. Survey two adult male family member (father, grandfather or uncle) and two adult female family members (mother, grandmother or aunt). Include the adults' first name, gender, age and relationship to you.

3.Record the results in your table. Also indicated the score they obtained:
i. yes=0; no=5
ii. yes=0; no=5
iii. yes=5; no=0
iv. yes=5; no=0
v. yes=5; no=0
vii. yes=0; no=5
4.Analyse the results by comparing the total score with the following descriptors:
30 marks- you take very good care of your heart. Well done!
25 marks- you take good care of your heart. Keep it up!
20 marks- you take reasonably good care of your heart but need to work on a few aspects where you scored 0.
15 marks- you need to take better care of your heart.
0-10 marks- you do not look after your heart at all. It's time to make a change to a healthier lifestyle.
Assessment Rubric

Results0- not done1- poorly presented. 2- average presentation of results, but missing some detail.3- average presentation of results, including all salient features and information.4- good presentation of results, but missing some detail.5- good presentation of results, including all salient features and information.		5

Table 2.4

2.10 UNIT 2.3 Transport Systems in Mammals - Blood Circulatory System[28]

2.10.1 Blood Circulatory System

Overview

[28]This content is available online at <http://cnx.org/content/m41385/1.1/>.

- All living cells require nutrients and oxygen to survive. Cells produce metabolic waste, which must be removed and excreted. The circulatory system is responsible from providing nutrients and removing metabolic waste.

Circulation takes place as follows:

- Unicellular organisms - diffusion
- Invertebrates – open ciculatory system
- **Vertebrates: closed circulatory**

2.10.2 Pulmonary and Systemic circulatory systems

Open ciculatory system – blood is pumped into a hemocoel (an open space or cavity) that surrounds to organs. Muscle movement also helps to pump then blood. Blood diffuses back the heart. Blood movement is sluggish. There is no difference between the blood and the interstitial fluid. Interstitial fluid is the fluid that surrounds the cells. Closed circulatory system – blood is pumped from the heart through arteries and returns to the heart via veins. Blood never leaves the vascular system(arteries, veins and capillaries). Nutrients, water and metabolic waste diffuses out of the vascular system and into the interstitial fluid. Interstitial fluid and blood are seperated, by the vascular system. Interstitial fluid returns to circulation through the lymphatic system. Systemic circulation (to all the systems): the blood is pumped from the heart to all parts of the body and back to the heart again. heart internal and external structure related to functioning Internally each half of the human heart is composed of a ventricle and atria. The valves of the heart ensure that blood only flows one way through the heart. The two chamber system of each half the of the heart allow one chamber to fill while the other is pumping blood. While the ventricle is contracting to pump blood into the artery, the atrium is relaxed and filling with blood. When the ventricle has completed its contraction, and relaxes the atrium then contracts to fill the ventricle. The heart maintains a rhythm between the contraction and relaxation of the atrium and ventricles. Because the heart is composed of two halves and each half is made up of two chambers the human heart is a four chamber heart. http://upload.wikimedia.org/wikipedia/commons/7/72/HROgg.ogg Title: Lungs and Pulmonary System; associated blood vessels Major organs and systemic system: associated major blood vessels of the brain, small intestine, liver, kidneys Mechanisms for controlling cardiac cycle and heart rate(pulse) Cardiac Magnetic Resonance imaging of Beating heart: Large magnets are used to create images of the heart inside the body, without the need for surgery. http://upload.wikimedia.org/wikipedia/commons/7/73/Four_chamber_cardiovascular_magnetic_resonance_imaging.gif View from the top http://commons.wikimedia.org/wiki/File:Beating_Heart_axial.gif View from the side http://commons.wikimedia.org/wiki/File:Cardiac_mri_ani_sagittal_bionerd.gif Blood Vessels Structure and functioning of arteries, veins and valves and capillaries Veins and arteries have three layers Outer layer – layer of connective tissue Middle layer – smooth muscle Inner layer – thin layer of squamous epithelial cells. Interactive diagram illustrating arterial and venous structure.http://www.phschool.com/science/biology_place/biocoach/cardio2/structure.html IKS

2.10.3 Open ciculatory system

Blood is pumped into a hemocoel (an open space or cavity) that surrounds to organs. Muscle movement also helps to pump then blood. Blood diffuses back the heart. Blood movement is sluggish. There is no difference between the blood and the interstitial fluid. Interstitial fluid is the fluid that surrounds the cells.

2.10.4 Closed circulatory system

Blood is pumped from the heart through arteries and returns to the heart via veins. Blood never leaves the vascular system(arteries, veins and capillaries). Nutrients, water and metabolic waste diffuses out of the vascular system and into the interstitial fluid. Interstitial fluid and blood are seperated, by the vascular system. Interstitial fluid returns to circulation through the lymphatic system.

2.10.5

Systemic circulation (to all the systems): the blood is pumped from the heart to all parts of the body and back to the heart again. Figure : heart internal and external structure related to functioning Internally each half of the human heart is composed of a ventricle and atria. The valves of the heart ensure that blood only flows one way through the heart. The two chamber system of each half the of the heart allow one chamber to fill while the other is pumping blood. While the ventricle is contracting to pump blood into the artery, the atrium is relaxed and filling with blood. When the ventricle has completed its contraction, and relaxes the atrium then contracts to fill the ventricle. The heart maintains a rhythm between the contraction and relaxation of the atrium and ventricles. Because the heart is composed of two halves and each half is made up of two chambers the human heart is a four chamber heart. Normal Heart Sounds http://upload.wikimedia.org/wikipedia/commons/7/72/HROgg.ogg Lungs and Pulmonary System; associated blood vessels Major organs and systemic system: associated major blood vessels of the brain, small intestine, liver, kidneys Mechanisms for controlling cardiac cycle and heart rate(pulse) Cardiac Magnetic Resonance imaging of Beating heart: Large magnets are used to create images of the heart inside the body, without the need for surgery. http://upload.wikimedia.org/wikipedia/commons/7/73/Four_chamber_cardiovascular_magnetic_resonance_imaging.gif View from the top http://commons.wikimedia.org/wiki/File:Beating_Heart_axial.gif. View from the side http://commons.wikimedia.org/wiki/File:Cardiac_mri_ani_sagittal_bionerd.gif Blood Vessels Structure and functioning of arteries, veins and valves and capillaries Veins and arteries have three layers Outer layer – layer of connective tissue Middle layer – smooth muscle Inner layer – thin layer of squamous epithelial cells. Interactive diagram illustrating arterial and venous structure. http://www.phschool.com/science/biology_place/biocoach/cardio2/structure.html Title: IKS

2.10.6

The Human Circulatory System

All mammals have a closed blood circulatory system - blood always flows inside blood vessels. A double circulatory system = blood passes through the heart twice:

1. Pulmonary circulation: the blood is pumped from the heart to the lungs to oxygenate the blood and then back to the heart.

2.10.7

Figure : heart internal and external structure related to functioning. Internally each half of the human heart is composed of a ventricle and atria. The valves of the heart ensure that blood only flows one way through the heart. The two chamber system of each half the of the heart allow one chamber to fill while the other is pumping blood. While the ventricle is contracting to pump blood into the artery, the atrium is relaxed and filling with blood. When the ventricle has completed its contraction, and relaxes the atrium then contracts to fill the ventricle. The heart maintains a rhythm between the contraction and relaxation of the atrium and ventricles. Because the heart is composed of two halves and each half is made up of two chambers the human heart is a four chamber heart.

2.10.8 Figure :

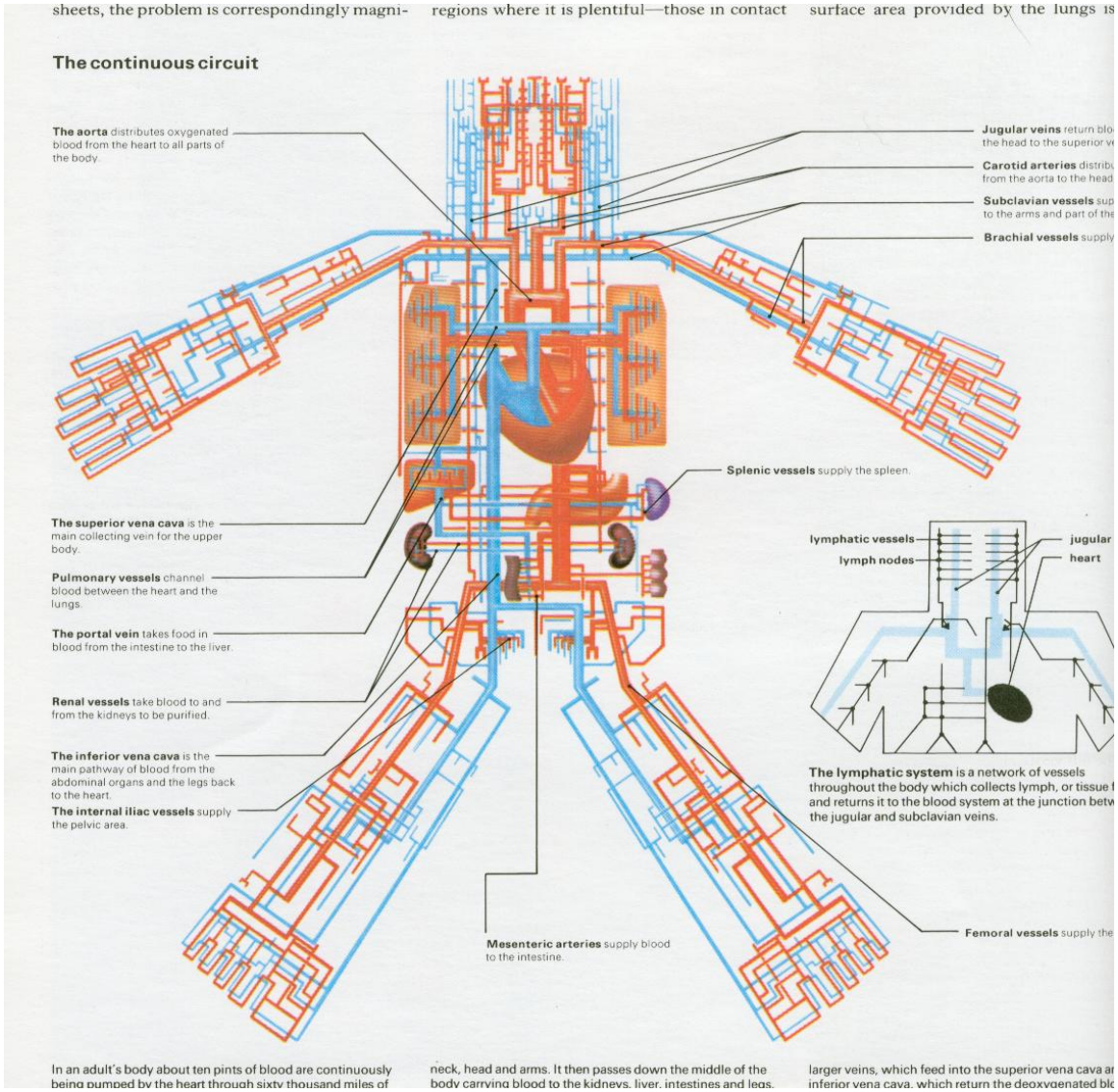


Figure 2.9

from flikr

Heart and associated blood vessels

The heart is a large muscle that pumps through repeated rhythmic contractions.. The heart is divided into a left and right half. The right half of the heart pumps blood up into the pulmonary artery, towards the lungs (pulmonary circulation), where it is oxygenated. Oxygenated blood returns from the lungs via the pulmonary veins and enters the left side of the heart. The left side of the heart then pumps blood up through the aorta, and into the general circulation (systemic circulation) and the oxygen is consumed by the body. Deoxygenated blood returns the the right side of the heart via the inferior (from below) and superior

(from above) vena cava, and can then be pumped back the the heart. The human circulatory system is a double circulatory system, because blood travels to the heart twice during circulation, once before going to the lungs and once before circulating throughout the body. Blood only flows in one direction, through the circulatory system.

- All vessels that flow Away from the heart are called Arteries (Aorta, Pulmonary artery).
- All blood vessels entering the heart are called Veins (Inferior and Superior vena cava, Pulmonary vein).
- **The terms artery and vein are not determined by what the vessel transports (oxygenated blood or deoxygenated) but by whether the vessel flows to or from the heart. Arteries carry blood away from the heart while veins carry blood towards the heart.**

Figure : General structure of the heart and associated blood vessels (http://en.wikipedia.org/wiki/File:Anatomy_Heart_English_Tiesworks.jpg)

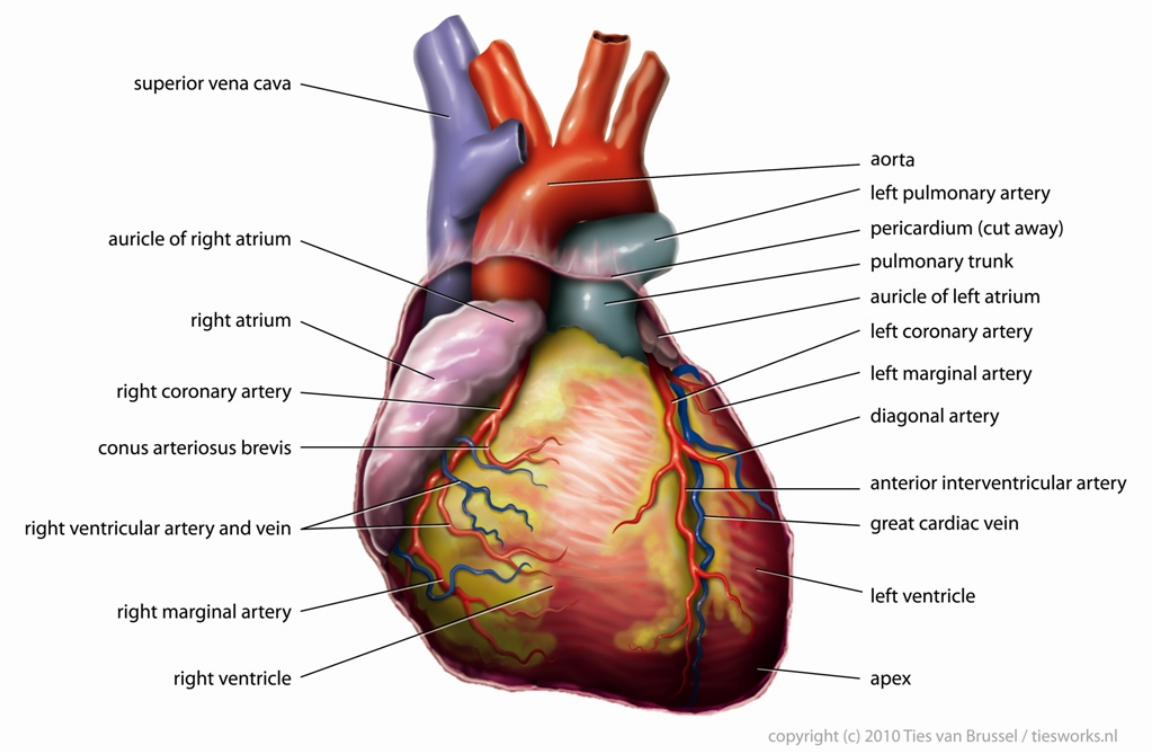


Figure 2.10

2.10.9 Internally each half of the human heart is composed of a ventricle and atria.

1. **Blood flow into an atrium from a vein.**
2. **Once the atrium is full it contracts pumping the blood into the a ventricle. When the atrium contracts a valve on the vein closes preventing blood from flowing back into the vein.**

3. **The ventricle then contracts pumping the blood into a artery. A valve between the ventricle and atrium prevents blood from flowing back into the atrium**

2.10.10

The valves of the heart ensure that blood only flows one way through the heart. The two chamber system of each half the of the heart allow one chamber to fill while the other is pumping blood. While the ventricle is contracting to pump blood into the artery, the atrium is relaxed and filling with blood. When the ventricle has completed its contraction, and relaxes the atrium then contracts to fill the ventricle. The heart maintains a rhythm between the contraction and relaxation of the atrium and ventricles.

2.10.11

Because the heart is composed of two halves and each half is made up of two chambers the human heart is a four chamber heart.

2.10.12

From mindset

Humans, birds, and mammals have a four-chambered heart. Fish have a two-chambered heart, one atrium and one ventricle . Amphibians have a three-chambered heart with two atria and one ventricle. The advantage of a four chambered heart is that there is no mixture of the oxygenated and deoxygenated blood.

Figure 10. Circulatory systems of several vertebrates showing the progressive evolution of the four-chambered heart and pulmonary and systemic circulatory circuits. Images from Purves et al., Life: The Science of Biology, 4th Edition, by Sinauer Associates (www.sinauer.com[29]) and WH Freeman (www.whfreeman.com[30]), used with permission. (please request permission to reprint these)

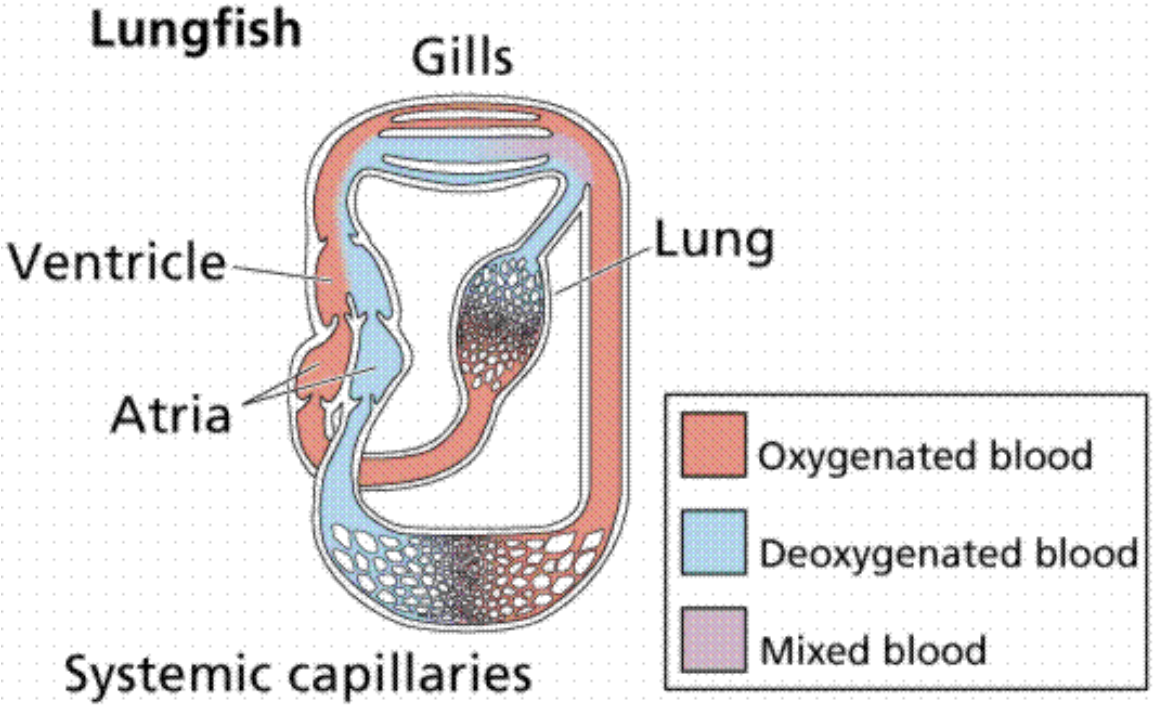
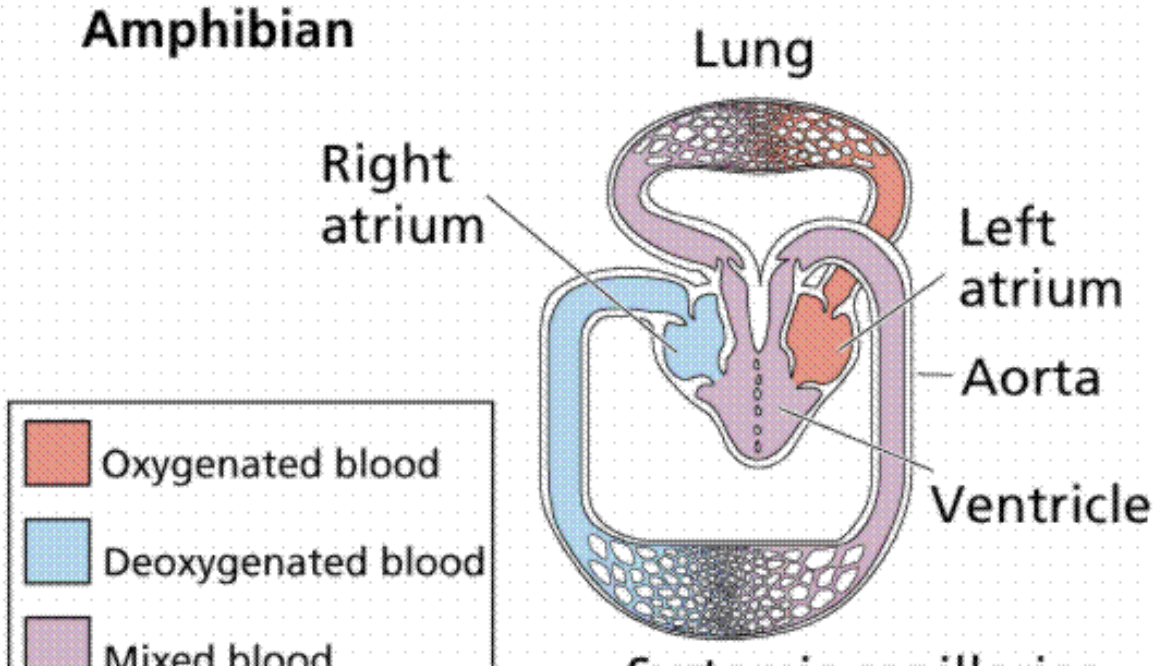


Figure 2.11



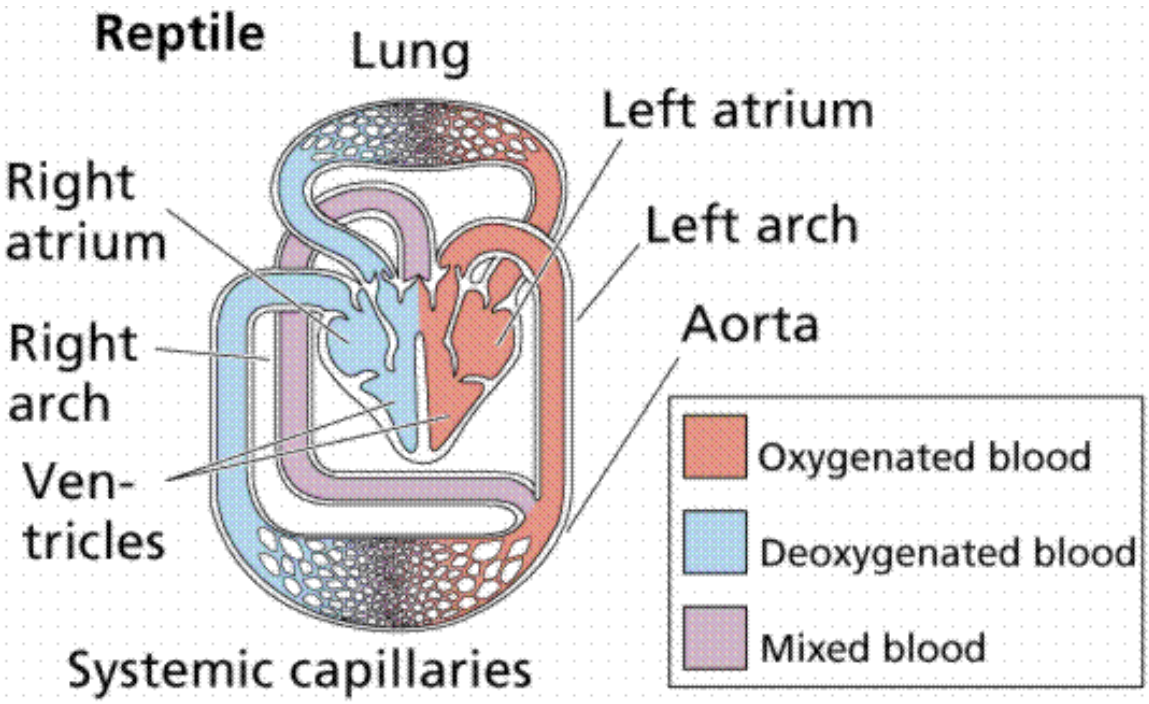


Figure 2.13

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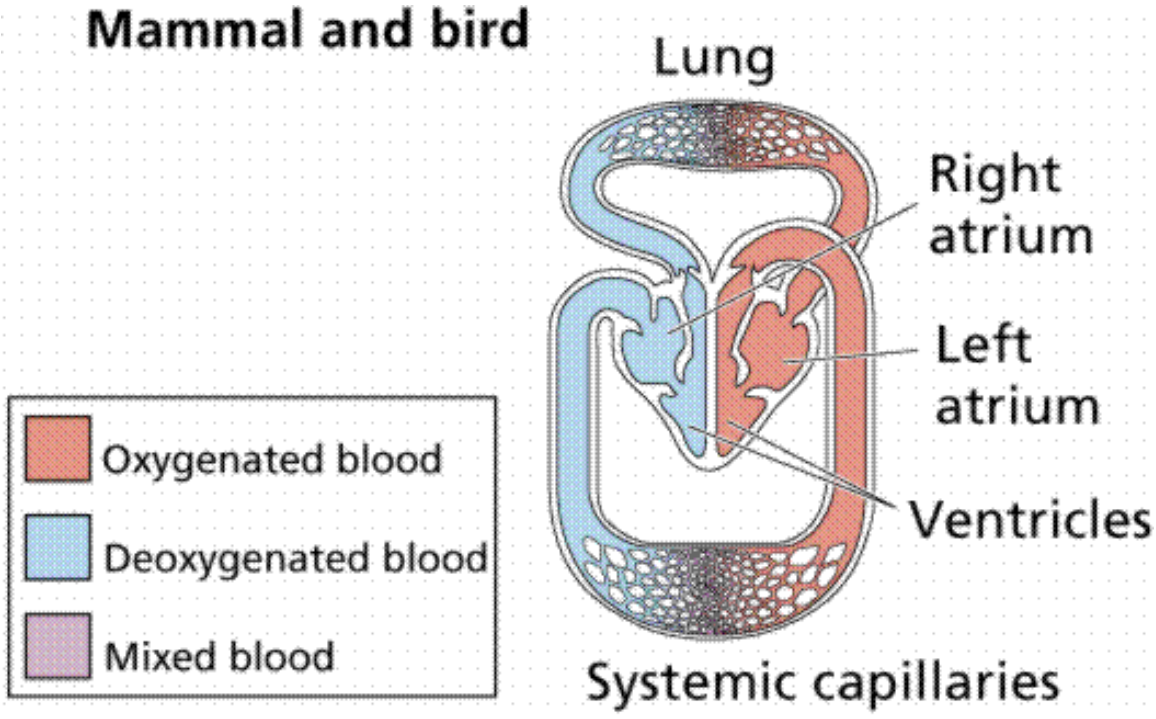

Figure 2.14

Table 2.5

The Heart

The heart, shown in Figure 11, is a muscular structure that contracts in a rhythmic pattern to pump blood. Hearts have a variety of forms: chambered hearts in mollusks and vertebrates, tubular hearts of arthropods, and aortic arches of annelids. Accessory hearts are used by insects to boost or supplement the main heart's actions. Fish, reptiles, and amphibians have lymph hearts[31] that help pump lymph[32] back into veins.

The basic vertebrate heart, such as occurs in fish, has two chambers. An auricle[33] is the chamber of the heart where blood is received from the body. A ventricle pumps the blood it gets through a valve from the auricle out to the gills through an artery.

Amphibians have a three-chambered heart: two atria emptying into a single common ventricle. Some species have a partial separation of the ventricle to reduce the mixing of oxygenated (coming back from the lungs) and deoxygenated blood (coming in from the body). Two sided or two chambered hearts permit pumping at higher pressures and the addition of the pulmonary loop permits blood to go to the lungs at lower pressure yet still go to the systemic loop at higher pressures.

[29] http://www.sinauer.com/
[30] http://www.whfreeman.com/
[31] http://www2.estrellamountain.edu/faculty/farabee/biobk/BioBookglossL.html#lymph%20hearts
[32] http://www2.estrellamountain.edu/faculty/farabee/biobk/BioBookglossL.html#lymph
[33] http://www2.estrellamountain.edu/faculty/farabee/biobk/BioBookglossA.html#auricle

Figure 11. The relationship of the heart and circulatory system to major visceral organs. Below: the structure of the heart. Images from Purves et al., Life: The Science of Biology, 4th Edition, by Sinauer Associates (www.sinauer.com[34]) and WH Freeman (www.whfreeman.com[35]), used with permission.

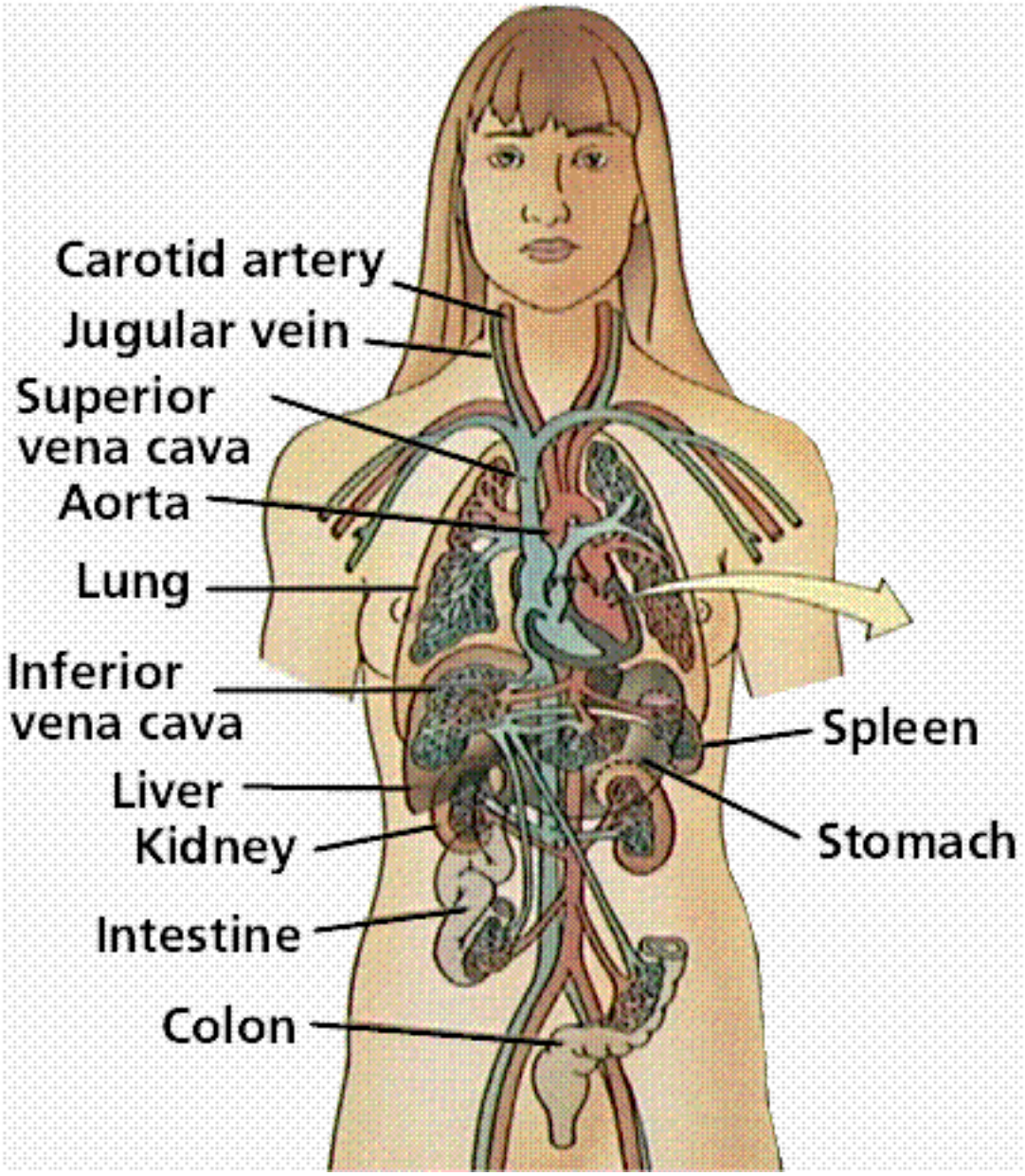

Figure 2.15

Table 2.6

Establishment of the four-chambered heart, along with the pulmonary and systemic circuits, completely separates oxygenated from deoxygenated blood. This allows higher the metabolic rates needed by warm-blooded birds and mammals.

The human heart, as seen in Figure 11, is a two-sided, four-chambered structure with muscular walls. An atrioventricular (AV) valve[36] separates each auricle from ventricle. A semilunar (also known as arterial) valve[37] separates each ventricle from its connecting artery.

The heart beats or contracts approximately 70 times per minute. The human heart will undergo over 3 billion contraction cycles, as shown in Figure 12, during a normal lifetime. The cardiac cycle[38] consists of two parts: systole[39] (contraction of the heart muscle) and diastole[40] (relaxation of the heart muscle). Atria contract while ventricles relax. The pulse is a wave of contraction transmitted along the arteries. Valves in the heart open and close during the cardiac cycle. Heart muscle contraction is due to the presence of nodal tissue in two regions of the heart.

Cardiac Cycle: flow of blood through the heart
Excellent simple video illustrating the heart cycle.
http://www.youtube.com/watch?v=D3ZDJgFDdk0[41]
The circulatory song
http://www.youtube.com/watch?v=q0s-1MC1hcE&NR=1[42]
The Cardiac Cycle

- The top half of the heart works as one unit.
- The bottom half of the heart works as one unit.
- The sino-atrial node (pacemaker) starts and regulates the process.
- To understand the cardiac cycle, note the following:
  - The duration of one heartbeat is approximately 0,8 seconds.
  - Normal heartbeat rate is approximately $72 - 75$ beats per minute.
  - The contraction of the heart muscle is called systole (think 'S' for stressed).
  - The relaxing of the heart muscle is called diastole

[34] http://www.sinauer.com/
[35] http://www.whfreeman.com/
[36] http://www2.estrellamountain.edu/faculty/farabee/biobk/BioBookglossA.html#atrioventricular%20%28AV%29%20valve
[37] http://www2.estrellamountain.edu/faculty/farabee/biobk/BioBookglossS.html#semilunar%20valve
[38] http://www2.estrellamountain.edu/faculty/farabee/biobk/BioBookglossC.html#cardiac%20cycle
[39] http://www2.estrellamountain.edu/faculty/farabee/biobk/BioBookglossS.html#systole
[40] http://www2.estrellamountain.edu/faculty/farabee/biobk/BioBookglossD.html#diastole
[41] http://www.youtube.com/watch?v=D3ZDJgFDdk0
[42] http://www.youtube.com/watch?v=q0s-1MC1hcE&NR=1

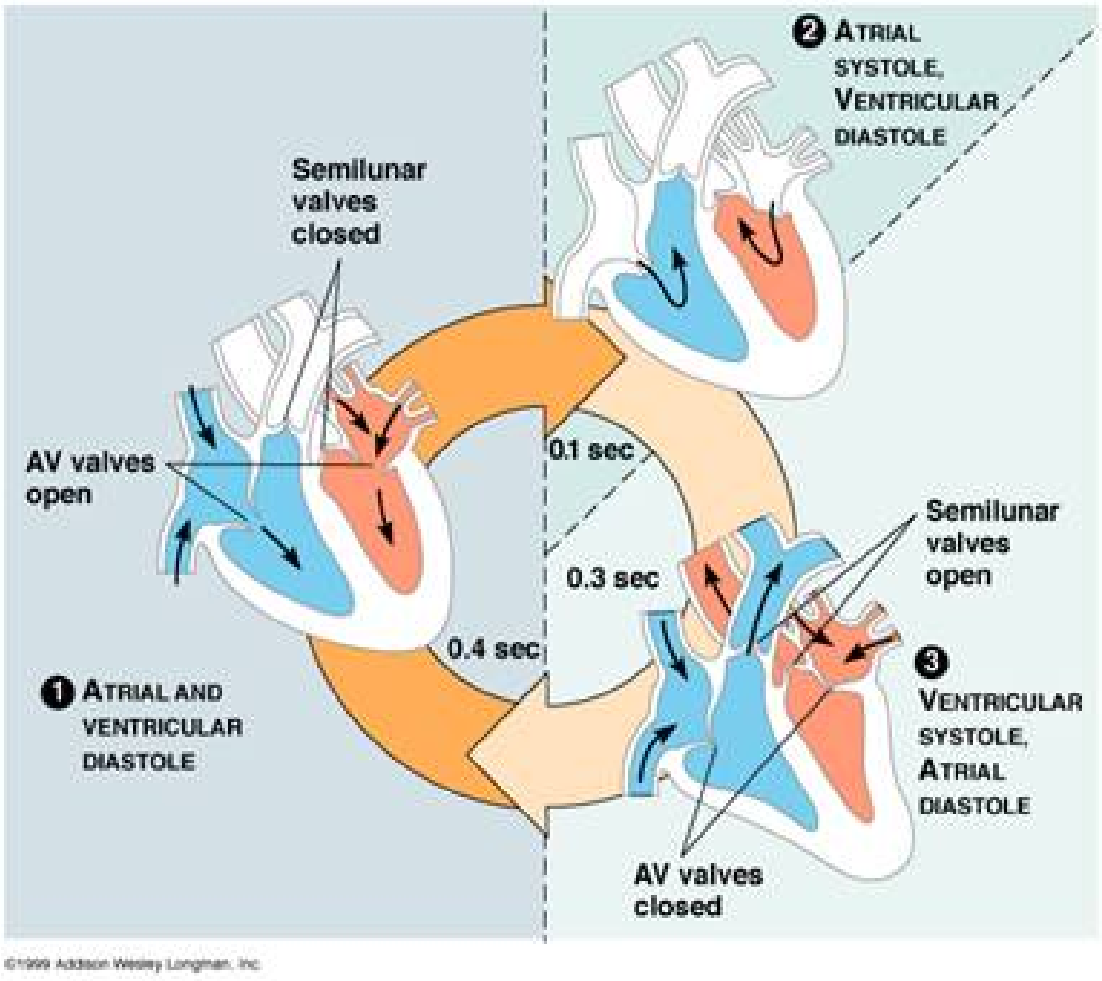

Figure 2.17

from mindset
One complete cycle of the human circulatory system.

1. Deoxygenated blood from the systemic circulation flows into the right atrium.
2. The right atrium contracts, closing the valve pulmonary semilunar valve, and pumping blood into the right ventricle.
3. The right ventricle contracts, closing the valve between the atrium and ventricle, and pumping the blood into the pulmonary circulation.
4. A valve on the pulmonary artery then closes preventing blood from flowing back into the heart.
5. Blood is oxygenated in the lungs and returns to the heart via the pulmonary arteries.
6. Blood flows into the left atrium.
7. The left atrium contracts, closing the valve, and pumps the blood into the left ventricle.
8. The left ventricle then contracts closing the valve between the ventricle and atrium, and pumps the blood into the aorta.

9. A valve on the aorta closes preventing the blood from flowing back into the heart. The high pressure from created by the ventricle forces the blood into the systemic circulation, where the cells of the body consume the oxygen.
10. Blood is returned to the heart via the veins. The veins contain valves allowing blood to only flow towards the heart. Blood is forced through the veins through muscle contractions.
11. Deoxygenated blood then returns to the heart, and the cycle continues.

Direction of Blood Flow: Difference Between Oxygenated and deoxygenated blood in different parts of the system (diagramatic or schematic drawing)

Blood flows through the heart from veins to atria to ventricles out by arteries. Heart valves limit flow to a single direction. One heartbeat, or cardiac cycle, includes atrial contraction and relaxation, ventricular contraction and relaxation, and a short pause. Normal cardiac cycles (at rest) take 0.8 seconds. Blood from the body flows into the vena cava, which empties into the right atrium. At the same time, oxygenated blood from the lungs flows from the pulmonary vein into the left atrium. The muscles of both atria contract, forcing blood downward through each AV valve into each ventricle.

Diastole is the filling of the ventricles with blood. Ventricular systole opens the SL valves, forcing blood out of the ventricles through the pulmonary artery or aorta. The sound of the heart contracting and the valves opening and closing produces a characteristic "lub-dub" sound. Lub is associated with closure of the AV valves, dub is the closing of the SL valves

Lung and pulmonary system and associated blood vessels: associated blood vessels

need to fill out this area

Major organs and systemic system: associated major blood vesssels the brain, small intestines, liver, kidney.

All the organs of the body are are supplied by blood. Each has a artery supplying the organ with blood from the heart, and veins returning blood to the heart. Arteries and veins have been named according to the organ which they supply blood to.

The circulatory system forms a closed system. Nutrients enter the circulatory system from the digestive system. These nutrients first move to the liver viat the haptic portal vein, the liver then controlls the nutrient composition of the blood. Blood passes from the liver to the heart for circulation throughout the body. Cells consume the nutrients in the blood and produce metabolic waste. This metabolic waste is circulated in the blood, if it remains in the blood the blood would eventually become toxic. The kidneys removing metabolic from the blood, maintaining a healthy environment for cells to live in.

The Brain is supplied with blood via the internal corotid arteries and the Verterbral arteries. The blood is drained via the jugular veins.

Mechanisms for controlling cardiac cycle and heart rate(pulse)

The rhythm of the heart is controlled by the The Sinoatrail node (SA node) which initiates the heartbeat, by triggering a an electical impulse which passes down to the other nerves in the heart. As then electical impulse passes over the atria they contract. The electrical impulse then reaches the atrioventricular (AV) nodes. The signal is delayed here, before passing over the ventricles, and initiating their contraction. This delay gives the ventricles time to fill before contracting.

"The SA node (sinoatrial node)[43] initiates heartbeat. The AV node (atrioventricular node)[44] causes ventricles to contract. The AV node is sometimes called the pacemaker since it keeps heartbeat regular. Heartbeat is also controlled by nerve messages originating from the autonomic nervous system.

Figure 12. The cardiac cycle. Image from Purves et al., Life: The Science of Biology, 4th Edition, by Sinauer Associates (www.sinauer.com[45]) and WH Freeman (www.whfreeman.com[46]), used with permission.

continued on next page

[43] http://www2.estrellamountain.edu/faculty/farabee/biobk/BioBookglossS.html#sinoatrial%20%28SA%29%20node
[44] http://www2.estrellamountain.edu/faculty/farabee/biobk/BioBookglossA.html#atrioventricular%20%28AV%29%20node

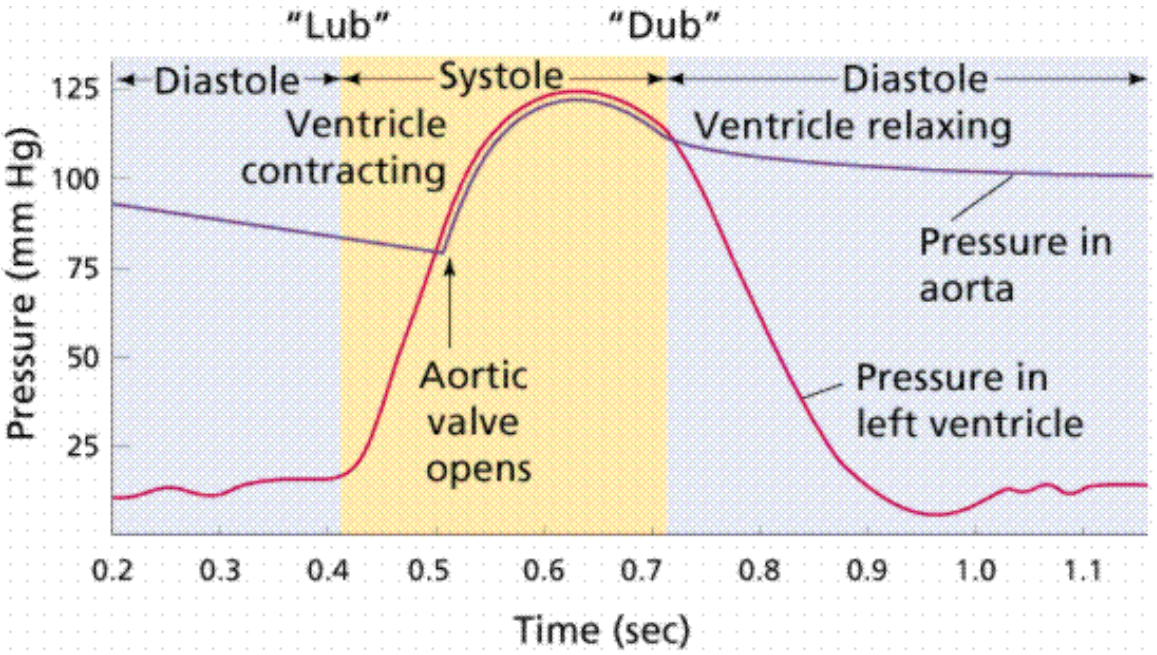

Figure 2.18

Table 2.7

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Human heartbeats originate from the sinoatrial node (SA node) near the right atrium. Modified muscle cells contract, sending a signal to other muscle cells in the heart to contract. The signal spreads to the atrioventricular node (AV node). Signals carried from the AV node, slightly delayed, through bundle of His fibers and Purkinjie fibers cause the ventricles to contract simultaneously. Figure 13 illustrates several aspects of this.

[45] http://www.sinauer.com/
[46] http://www.whfreeman.com/

Figure 13. The contraction of the heart and the action of the nerve nodes located on the heart. Images from Purves et al., Life: The Science of Biology, 4th Edition, by Sinauer Associates (www.sinauer.com[47]) and WH Freeman (www.whfreeman.com[48]), used with permission.

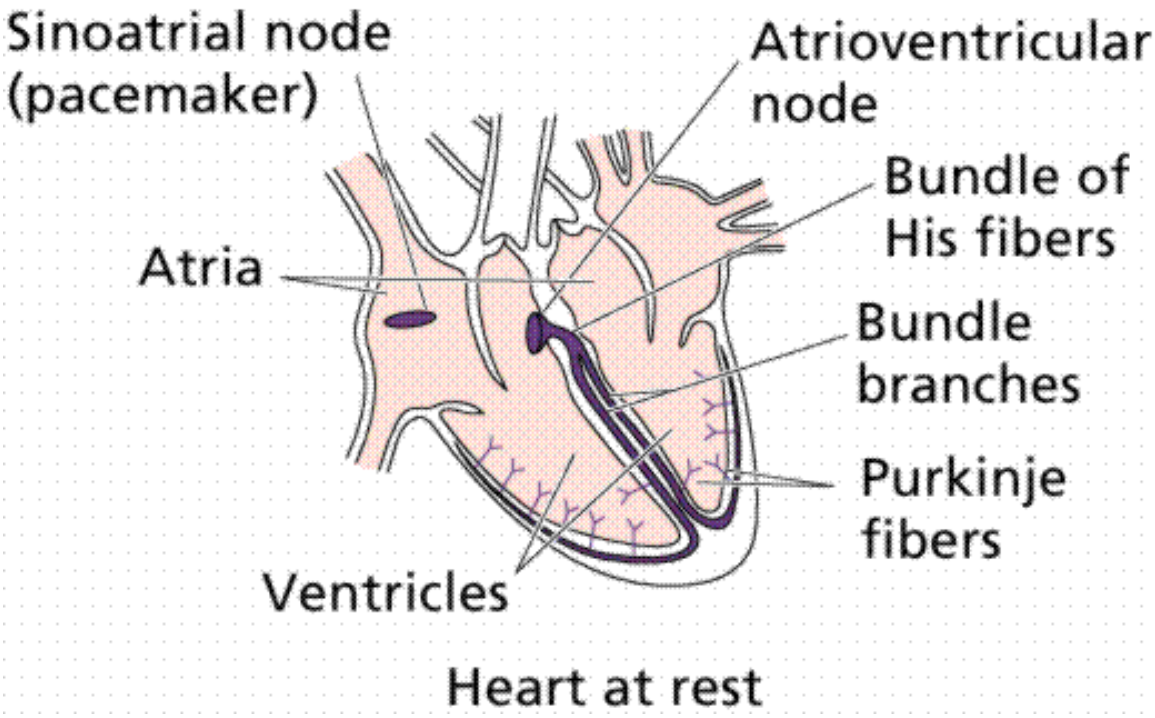
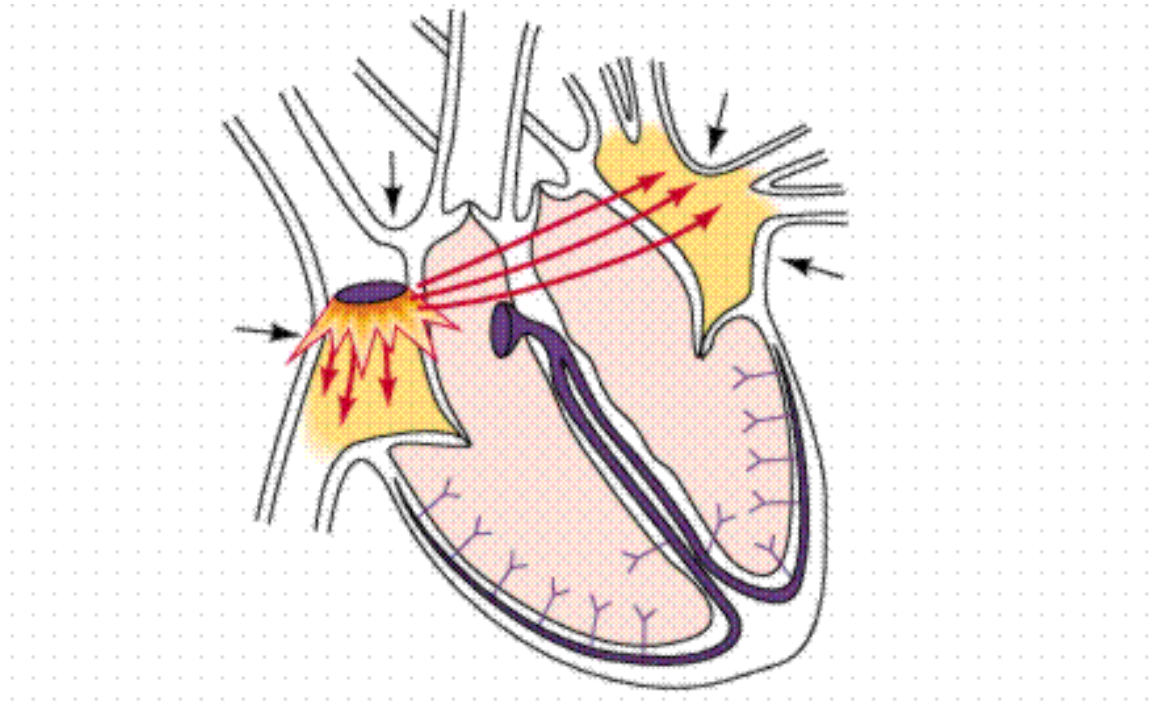


Figure 2.19



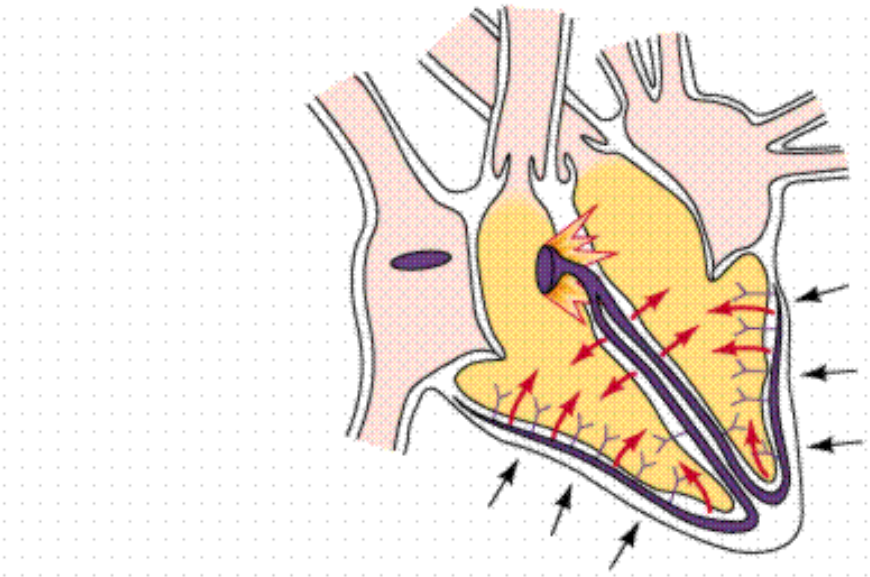


Figure 2.21

Table 2.8

Heartbeats are coordinated contractions of heart cardiac cells, shown in an animate GIF image in Figure 14. When two or more of such cells are in proximity to each other their contractions synch up and they beat as one.

Table 2.9

An electrocardiogram (ECG) measures changes in electrical potential across the heart, and can detect the contraction pulses that pass over the surface of the heart. There are three slow, negative changes, known as P, R, and T as shown in Figure 15 . Positive deflections are the Q and S waves. The P wave represents the contraction impulse of the atria, the T wave the ventricular contraction. ECGs are useful in diagnosing heart abnormalities.

[47] http://www.sinauer.com/
[48] http://www.whfreeman.com/

Figure 15. Normal cardiac pattern (top) and some abnormal patterns (bottom). Images from Purves et al., Life: The Science of Biology, 4th Edition, by Sinauer Associates (www.sinauer.com[49]) and WH Freeman (www.whfreeman.com[50]), (please contact for permission).

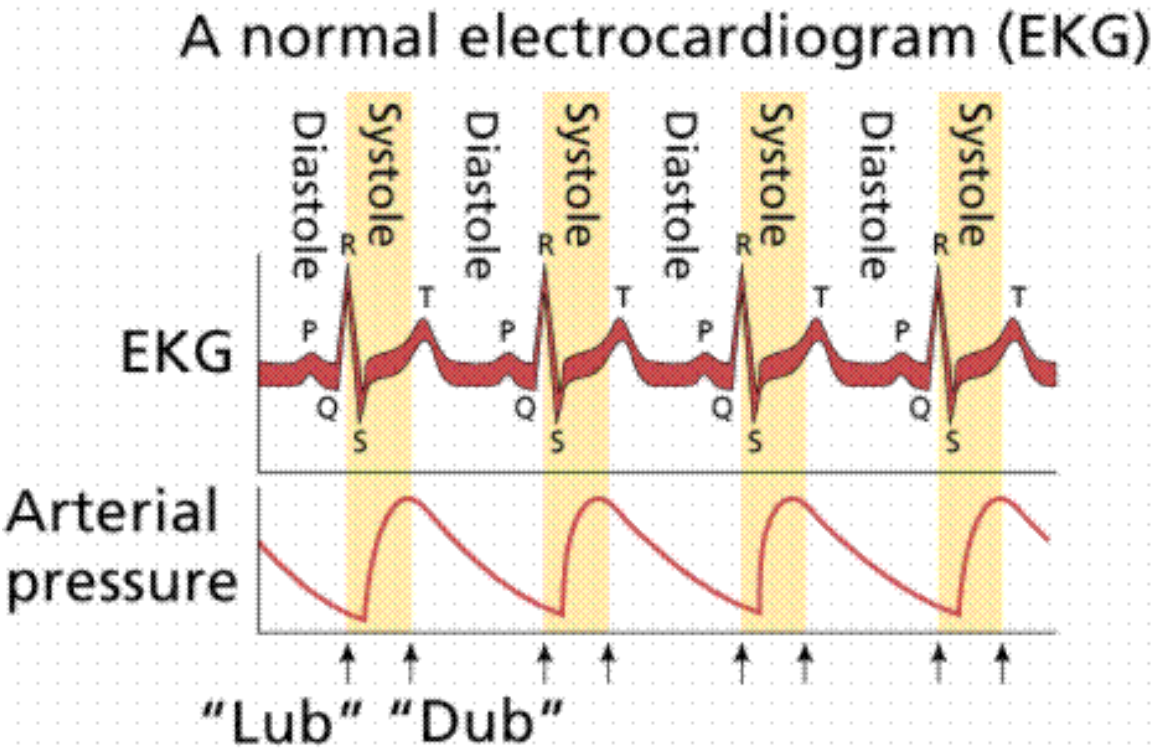


Figure 2.22

continued on next page

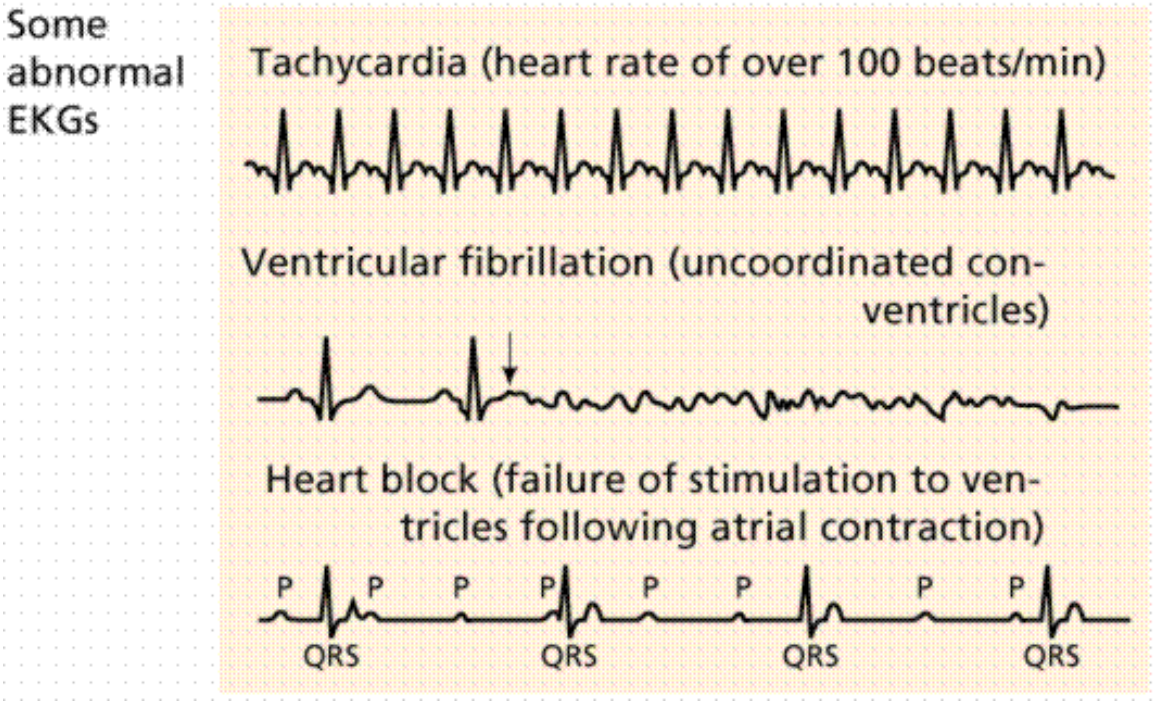


Figure 2.23

Table 2.10

The heart consists of a right and left half, blood is never mixed in the two halves. The right half of the heart pumps blood to the lungs (pulmonary circulation), the blood is oxygenated in the lung, and returns to the left side of the heart. The left side of the heart then pumps the blood to the rest of the body (systemic circulation), the blood then returns to right side of the heart and can be pumped back into the lungs. Blood leaves the heart through arteries and returns to the heart via veins.

http[51] ://[52] www[53] .[54] biologyinmotion[55] .[56] com[57] /[58] cardio[59] /[60] index[61] .[62] html[63]

Khan Academy

[49] http://www.sinauer.com/
[50] http://www.whfreeman.com/
[51] http://www.biologyinmotion.com/cardio/index.html
[52] http://www.biologyinmotion.com/cardio/index.html
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2.10.13 Normal Heart Sounds

http://upload.wikimedia.org/wikipedia/commons/7/72/HROgg.ogg[110]

2.10.14 Outer layer – layer of connective tissue

Middle layer – smooth muscle Inner layer – thin layer of squamous epithelial cells. Interactive diagram illustrating arterial and venous structure. http://www.phschool.com/science/biology_place/biocoach/cardio2/structure.html IKS

[64] http://www.khanacademy.org/video/circulatory-%20system-and-the-heart?playlist=Biology
[65] http://www.khanacademy.org/video/circulatory-%20system-and-the-heart?playlist=Biology
[66] http://www.khanacademy.org/video/circulatory-%20system-and-the-heart?playlist=Biology
[67] http://www.khanacademy.org/video/circulatory-%20system-and-the-heart?playlist=Biology
[68] http://www.khanacademy.org/video/circulatory-%20system-and-the-heart?playlist=Biology
[69] http://www.khanacademy.org/video/circulatory-%20system-and-the-heart?playlist=Biology
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[109] http://www.khanacademy.org/video/the-lungs-and-%20pulmonary-system?playlist=Biology
[110] http://upload.wikimedia.org/wikipedia/commons/7/72/HROgg.ogg

2.10.15 Middle layer – smooth muscle

thin layer of squamous epithelial cells. Interactive diagram illustrating arterial and venous structure. http://www.phschool.com/science/biology_place/biocoach/cardio2/structure.html

2.10.16 Inner layer – thin layer of squamous epithelial cells.

Interactive diagram illustrating arterial and venous structure. http://www.phschool.com/science/biology_place/biocoach/car

2.10.17 Interactive diagram illustrating arterial and venous structure.

http://www.phschool.com/science/biology_place/biocoach/cardio2/structure.html IKS

2.10.18 IKS

Use and symbololgy of blood and heart in traditional black culture

Doing a dissection

http://www.hometrainingtools.com/images/videos/Dissection_Video/dissection_flvplayer.html?TB_iframe=true&heigh

[111] http://www.hometrainingtools.com/images/videos/Dissection_Video/dissection_flvplayer.html?TB_iframe=true&height=390&width=405

Chapter 3

Environmental studies

3.1 Biosphere[1]

3.1.1 Biosphere

3.1.1.1 1.1 Concept of the Biosphere

In the past scientists have studied the various parts of the Earth. They have looked at botany (how plants work), zoology (animals), geology (rocks), and physics (forces) but few have studied how all of these work together. Now we are discovering that the Earth is much more than a bunch of parts. It is a whole. The Earth is a whole system that works together. This means that there is an interconnection between all of Earth's living and non-living parts. Everything works together in important ways. Scientists divide the Earth's System into four sub-systems:

- biosphere (life)
- lithosphere (land)
- hydrosphere (water)
- atmosphere (air)

To see how the sub-systems of the Earth interact, watch the video: The Earth as a System: http://www.oercommons.org/courses/earth-as-a-system/view[2]

3.1.1.1.1 1.1.1 Biosphere

From: http://cnx.org/content/m16693/latest/?collection=col10548/latest

The biosphere is the region of the earth that encompasses all living organisms: plants, animals and bacteria. It is a feature that distinguishes the earth from the other planets in the solar system. "Bio" means life, and the term biosphere was first coined by a Russian scientist (Vladimir Vernadsky) in the 1920s. Another term sometimes used is ecosphere ("eco" meaning home). The biosphere includes the outer region of the earth (the lithosphere) and the lower region of the atmosphere (the troposphere). It also includes the hydrosphere, the region of lakes, oceans, streams, ice and clouds comprising the earth's water resources. Traditionally, the biosphere is considered to extend from the bottom of the oceans to the highest mountaintops, a layer with an average thickness of about 20 kilometers. Scientists now know that some forms of microbes live at great depths, sometimes several thousand meters into the earth's crust.

Nonetheless, the biosphere is a very tiny region on the scale of the whole earth, analogous to the thickness of the skin on an apple. The bulk of living organisms actually live within a smaller fraction of the biosphere, from about 500 meters below the ocean's surface to about 6 kilometers above sea level.

[1] This content is available online at <http://cnx.org/content/m41384/1.1/>.

[2] http://www.oercommons.org/courses/earth-as-a-system/view

Dynamic interactions occur between the biotic region (biosphere) and the abiotic regions (atmosphere, lithosphere and hydrosphere) of the earth. Energy, water, gases and nutrients are exchanged between the regions on various spatial and time scales. Such exchanges depend upon, and can be altered by, the environments of the regions. For example, the chemical processes of early life on earth (e.g. photosynthesis, respiration, carbonate formation) transformed the reducing ancient atmosphere into the oxidizing (free oxygen) environment of today. The interactive processes between the biosphere and the abiotic regions work to maintain a kind of planetary equilibrium. These processes, as well as those that might disrupt this equilibrium, involve a range of scientific and socioeconomic issues.

The study of the relationships of living organisms with one another and with their environment is the science known as ecology. The word ecology comes from the Greek words oikos and logos, and literally means "study of the home." The ecology of the earth can be studied at various levels: an individual (organism), a population, a community, an ecosystem, a biome or the entire biosphere. The variety of living organisms that inhabit an environment is a measure of its biodiversity.

3.1.1.1.2 1.1.2 Lithosphere

From:http://www.curriki.org/xwiki/bin/view/Coll_NROCscience/Lesson14TheLithosphereandPlateTectonics_0

The layer of the mantle above the asthenosphere plus the entire crust make up a region called the lithosphere. The lithosphere, and therefore, the earth's crust, is not a continuous shell, but is broken into a series of plates that independently "float" upon the asthenosphere, much like a raft on the ocean. These plates are in constant motion, typically moving a few centimeters a year, and are driven by convection in the mantle. The scientific theory that describes this phenomenon is called plate tectonics. According to the theory of plate tectonics, the lithosphere is comprised of some seven major plates and several smaller ones. Because these plates are in constant motion, interactions occur where plate boundaries meet.

3.1.1.1.3 1.1.3 Hydrosphere

From Open Source Earth Science Course (www.opencollegetextbook.org)

The Hydrosphere contains all the water on Earth. As groundwater, the hydrosphere penetrates the soil as far down as bedrock, mostly limestone, or other impermeable layers. It is found in aquifers as groundwater and also between soil particles. As surface water, it is found in wetlands, marshes, estuaries, lakes, streams, rivers, lakes, seas, and oceans. In the atmosphere, water is found as a gas throughout the different regions. Water appears to permeate all the other spheres.

The Hydrosphere extends upward to about 15 kilometers in the Earth's atmosphere and downward to depths on the order of five kilometers in its crust. Indeed, the abundance of water on Earth is a unique feature that clearly distinguishes our "Blue Planet" from others in the solar system. Not a drop of liquid water can be found anywhere else in the solar system.

Though it cannot be found on any other planet, water is the most abundant inorganic substance at the surface of the Earth. About 1.4 billion cubic kilometers of water in liquid and frozen form make up the oceans, lakes, rivers, streams, glaciers, and groundwater.

3.1.1.1.4 1.1.4 Atmosphere

The atmosphere, the gaseous layer that surrounds the earth, formed over four billion years ago. The earth's atmosphere extends outward to about 1,000 kilometers where it transitions to interplanetary space. However, most of the mass of the atmosphere (greater than 99 percent) is located within the first 40 kilometers. The sun and the earth are the main sources of radiant energy in the atmosphere. The sun's radiation spans the infrared, visible and ultraviolet light regions, while the earth's radiation is mostly infrared.

The vertical temperature profile of the atmosphere is variable and depends upon the types of radiation that affect each atmospheric layer. This, in turn, depends upon the chemical composition of that layer (mostly involving trace gases). Based on these factors, the atmosphere can be divided into four distinct layers: the troposphere, stratosphere, mesosphere, and thermosphere.

The troposphere is the atmospheric layer closest to the earth's surface. It extends about 8 - 16 kilometers from the earth's surface. The thickness of the layer varies a few km according to latitude and the season of the year. It is thicker near the equator and during the summer, and thinner near the poles and during the winter. The troposphere contains the largest percentage of the mass of the atmosphere relative to the other layers. It also contains some 99 percent of the total water vapor of the atmosphere.

The temperature of the troposphere is warm (roughly 17º C) near the surface of the earth. This is due to the absorption of infrared radiation from the surface by water vapor and other greenhouse gases (e.g. carbon dioxide, nitrous oxide and methane) in the troposphere. The concentration of these gases decreases with altitude, and therefore, the heating effect is greatest near the surface. The temperature in the troposphere decreases at a rate of roughly 6.5º C per kilometer of altitude. The temperature at its upper boundary is very cold (roughly -60º C).

Because hot air rises and cold air falls, there is a constant convective overturn of material in the troposphere. Indeed, the name troposphere means "region of mixing." For this reason, all weather phenomena occur in the troposphere. Water vapor evaporated from the earth's surface condenses in the cooler upper regions of the troposphere and falls back to the surface as rain. Dust and pollutants injected into the troposphere become well mixed in the layer, but are eventually washed out by rainfall. The troposphere is therefore self cleaning.

A narrow zone at the top of the troposphere is called the tropopause. It effectively separates the underlying troposphere and the overlying stratosphere. The temperature in the tropopause is relatively constant. Strong eastward winds, known as the jet stream, also occur here.

The stratosphere is the next major atmospheric layer. This layer extends from the tropopause (roughly 12 kilometers) to roughly 50 kilometers above the earth's surface. The temperature profile of the stratosphere is quite different from that of the troposphere. The temperature remains relatively constant up to roughly 25 kilometers and then gradually increases up to the upper boundary of the layer. The amount of water vapor in the stratosphere is very low, so it is not an important factor in the temperature regulation of the layer. Instead, it is ozone (O3) that causes the observed temperature inversion.

The third layer in the earth's atmosphere is called the mesosphere. It extends from the stratopause (about 50 kilometers) to roughly 85 kilometers above the earth's surface. Because the mesosphere has negligible amounts of water vapor and ozone for generating heat, the temperature drops across this layer. It is warmed from the bottom by the stratosphere. The air is very thin in this region with a density about 1/1000 that of the surface. With increasing altitude this layer becomes increasingly dominated by lighter gases, and in the outer reaches, the remaining gases become stratified by molecular weight.

The fourth layer, the thermosphere, extends outward from about 85 kilometers to about 600 kilometers. Its upper boundary is ill defined. The temperature in the thermosphere increases with altitude, up to 1500º C or more. The high temperatures are the result of absorption of intense solar radiation by the last remaining oxygen molecules. The temperature can vary substantially depending upon the level of solar activity.

The lower region of the thermosphere (up to about 550 kilometers) is also known as the ionosphere. Because of the high temperatures in this region, gas particles become ionized. The ionosphere is important because it reflects radio waves from the earth's surface, allowing long-distance radio communication. The visual atmospheric phenomenon known as the northern lights also occurs in this region. The outer region of the atmosphere is known as the exosphere. The exosphere represents the final transition between the atmosphere and interplanetary space. It extends about 1000 kilometers and contains mainly helium and hydrogen. Most satellites operate in this region.

3.1.1.2 1.2 Interconnectedness with, and components of a global ecosystem

Concept: the earth is a system

Text from Open Source Earth Science Course

While studying the parts of the Earth System it is important to look for the emergent properties of the Earth System. How do the parts of the Earth System come together to form a sum that is greater than the sum of its parts? This question is best answered by focusing on the Earth's matter, energy, and life.

A system has two distinguishing characteristics. The first is that it has SYNERGY. Synergy means that the whole is greater than the sum of the parts. This sounds a lot more complicated than it is. What it means is that when all of the pieces of a system are put together they are more valuable than all of the pieces would be if they were considered separately. A home is a good example. If you were to lay all the pieces and parts of your home in a pile you would have a big pile of wood, insulation, pipes, wires, drywall, etc. Your pile of "house stuff" would be worth something but not nearly as much as your home is worth when all the "house stuff" is organized into a system.

The second distinguishing characteristic of a system is that it has EMERGENT PROPERTIES. Emergent properties are properties that emerge as a result of how the system works together; properties that do not exist without the system. In other words, emergent properties are characteristics that are unique to the system as a whole. Let us consider the example of your home once again. Some emergent properties of your home may be its comfort and its safety. The comfort of your home is a function of the materials used to build it, the architectural design, and the furniture inside. The home's safety is a property dependent on the design, the strength and location of its doors and windows, and the neighbourhood in which it was built. Both the safety and comfort of your home are properties of the home that are a result of the "home system"; they are not dependent on just one aspect of the home.

_ Text from Earth as a System. " Teachers' Domain. 17 Dec. 2005. Web. 15 Oct. 2011. <http://www.teachersdomain.org/resource/ess05.sci.ess.earthsys.hologlobe/"

Understanding our planet as an integrated system of components and processes is a fundamental part of Earth and space science research. Just as the human body is composed of interrelated systems that control specific bodily functions, Earth's four principal components — the atmosphere (air), lithosphere (land), hydrosphere (water), and biosphere (life) — perform critical roles that, together, support and sustain life on the planet.

Nothing influences the subsystems that contribute to Earth's dynamic behaviour more than heat. Heat comes from two sources: solar energy and radioactivity in the Earth's core. Because of the angle at which the Sun strikes Earth, Earth's surface is heated unevenly. This creates Earth's three major climate zones — tropical, temperate, and polar — which then influence what types of life flourish in different locations.

The uneven heating also controls weather systems. The heat absorbed by the oceans and carried by its currents is constantly being released into the atmosphere. This heat and moisture drive atmospheric circulation and set weather patterns in motion. The weather patterns then influence vegetation, as well as erosion and sediment transport.

The other heat source, deep within Earth's core, is responsible for plate tectonics, which gives the Earth its physical character: mountain ranges and valleys, ocean basins and lake beds, and islands and trenches. The heat from Earth's core generates convection cells within its mantle, which help drive plate activity.

Ever since the first photos were sent back from space, our view of Earth has changed. Remote sensing instruments, such as satellites, allow us to better understand the interrelationships between the different subsystems. For instance, recordings made by remote and Earth-based instruments show that significant surface warming has occurred over the past three decades. Knowing this, scientists are working to determine how this will affect — and already is affecting — the entire Earth system.

Possible slide-shows:

http://www.slideshare.net/Alyssa10/earth-science-biosphere-ppt[3]

http://www.slideshare.net/shoreyl/3-biosphere[4]

Video: The Earth as a System: http://www.oercommons.org/courses/earth-as-a-system/view[5]

3.1.1.3 1.3 Questions

What are the parts of Earth's System?

What are the properties of the Earth's System?

How is the Earth's System part of a larger system?

[3] http://www.slideshare.net/Alyssa10/earth-science-biosphere-ppt

[4] http://www.slideshare.net/shoreyl/3-biosphere

[5] http://www.oercommons.org/courses/earth-as-a-system/view

3.2 Environment[6]

3.2.1 Environment

3.2.1.1 Concept of environment to show human activities in and interactions with the natural environment

Throughout history humans have influenced, and been influenced by, the natural world. While much of our impact has been detrimental to the natural environment, we have preserved and protected certain resources that are important to us. There are currently many uncertainties regarding the future of the natural environment, and the role of humans in its destruction and responsibility of humans in its conservation and preservation. Environmental problems are becoming more and more complex, especially as issues arise on a more global level, such as that of atmospheric pollution or global warming. There is a realization that such complex problems will demand complex solutions and the participation of all.

Interactions between human society and the environment are constantly changing. The environment, while highly valued by most, is used and altered by a wide variety of people with many different interests and values. Difficulties remain on how best to ensure the protection of our environment and natural resources. There will always be tradeoffs and, many times, unanticipated or unintended consequences. However, a well-managed environment can provide goods and services that are both essential for our well being as well as for continued economic prosperity.

The environment has become one of the most important issues of our time and will continue to be well into the future. The challenge is to find approaches to environmental management that give people the quality of life they seek while protecting the environmental systems that are also the foundations of our well being. In order to face these challenges, students today will need more than superficial knowledge or awareness of disconnected environmental issues. A multidisciplinary approach to learning can build upon the strengths of a wide range of fields of study, providing a deeper understanding of the technological, political, and social options and strategies for both studying and managing the relationship between our society and the environment.

From the Environmental Literacy Council. Unsure of copyright.

Land Use

The surface of the Earth is shaped by a combination of physical processes, including earthquakes and volcanoes, shifts of rocks and sediments, and flows of river and ice. Humans also shape the land through increasing populations, agricultural expansion, mineral and forest resource excavation, changing the flow of rivers, and with layers of industrial and urban infrastructure. Land cover is the physical and biological material found on the surface of the land, existing as vegetation or the built environment (human-created structures). Land use describes the various ways in which human beings make use of and manage the land and its resources.

Over the course of history, humans have had a changeable relationship to the land. Early humans are believed to have used the land with little modification for shelter, food gathering, and defensive aims. It wasn't until the domestication of plants and animals approximately 10,000 years ago that land use involved extensive changes in the landscape. With domestication came large-scale clearing for both settlement and agriculture. Growing populations built structures on the land (or out of the land) for shelter, defense and worship, and altered the existing land cover and the course of waterways for food, power, and transportation.

In many instances, the biological and physical make-up of the land contributes to how it is used; lands with rich soils are most suitable for farming while lands prone to flooding are less suitable for settlement. Large cities, for example, are often located adjacent to an ocean or river, providing essential water, and access for food, sewer, industrial, and economic purposes. As food, power, transportation, and communication technologies transformed over the last few centuries in order to meet the needs of a rapidly expanding population, there have been major changes in the patterns of land use worldwide.

During the 18th and 19th centuries, many acres of forest were cleared to make way for cropland, and for use as fuel and building material. In many developed countries that trend is reversing, and the regeneration of

[6]This content is available online at <http://cnx.org/content/m41346/1.1/>.

vegetation is occurring. However, in many developing countries, deforestation and unsustainable agricultural practices are still a major concern. Yet, worldwide, the most transformative change has been in the decrease of cropland and the increase of urban land .

Today, industrial areas are more apt to be found in suburban locales rather than in inner cities, while areas dedicated to natural resource extraction and production continue to be found most often in rural areas. Modern city life is marked by large commercial and residential spaces, with impermeable surfaces punctuated by the occasional green space. These areas are connected by a vast transportation network that snakes across land and water, exchanging people, goods, and natural resources between the urban, suburban, and rural areas. Land use decisions have since moved from the single farmer deciding where to place his crops to a more integrated view of land use planning.

3.2.1.2 Abiotic and biotic factors: effects on the community

There a number of characteristics of your local environment that can be classified into three broad categories, which can be called the the "ABC's of the environment."

In the ABC's of the environment,

A- refers to the abiotic (physical, non-living) features of the area
B- identifies the biotic (plant and animal) component of the environment.
C- C is the cultural (human) influences.

Some ecologists think of the ABC's as forming a triangle with inter-relating sides. In a civilization as complex as ours, no single side can exist uninfluenced by others.

3.2.1.3 How Humans have an impact on the environment

3.2.1.3.1 The Greenhouse Effect

http://www.curriki.org/xwiki/bin/view/Coll_Athabasca/Unit5-Lesson3TheGreenhouseEffect

With the rise to prominence of the issue of global warming, it is important to discuss the greenhouse effect here. The name comes from the everyday concept of a greenhouse, where sunlight is allowed to pass through transparent panels and shine on the plants inside. This provides energy to the plants, but also warms everything inside the greenhouse. With the sealed layer of transparent panels, the warmth is trapped inside and the greenhouse becomes much warmer than the environment outside.

The Earth's atmosphere functions exactly like this, except there are no transparent panels. When sunlight shines down on the Earth, most of it is absorbed on the surface, giving us warmth and energy. Some of the light is absorbed by the atmosphere before it hits the surface, and a very small amount of the light is also reflected back off the surface toward outer space. Additionally, the surface of the Earth releases heat into the atmosphere, such as can be seen over a road on a hot day.

Did you know?

The greenhouse effect is not limited to Earth. Any planet that has a significant atmosphere has some kind of greenhouse effect. Venus has a significant greenhouse effect that keeps the surface of the planet extremely hot, averaging around 460 $^{\circ}$ C. A probe that was sent to study the planet survived for only two hours before melting, even though it was designed with durable metals.

The Sun's rays warm the around in Earth's atmosphere

With the reflection of light off the surface and the surface radiation of heat, much of the energy from sunlight would be lost back to space. Fortunately the atmosphere acts like the transparent panels from the greenhouse trapping the heat. Natural gases in our atmosphere called greenhouse gases (such as carbon dioxide and water vapour) are extremely good at absorbing various kinds of sunlight. So, rather than escaping back into space, much of this reflected light and heat is actually absorbed by the greenhouse gases. This has a significant warming effect on our atmosphere.

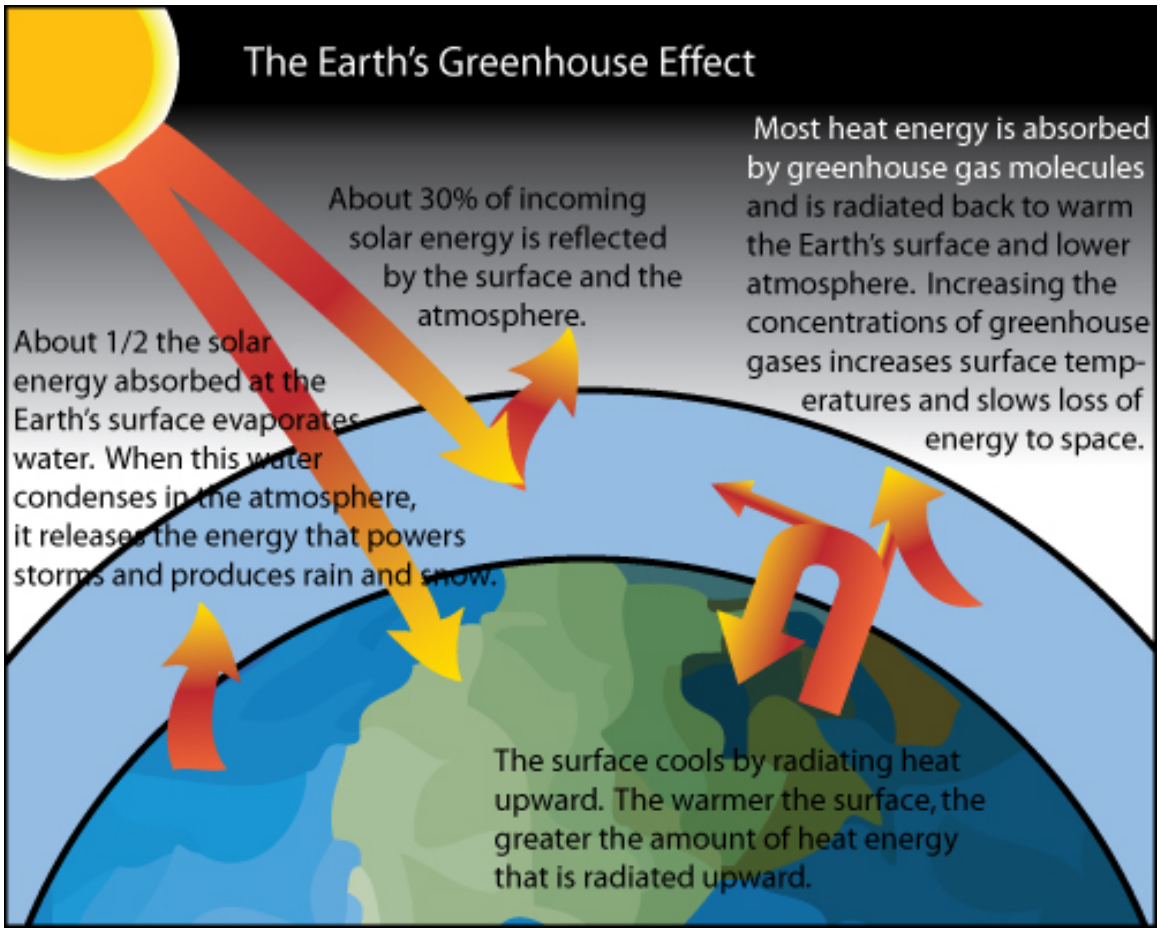

Figure 3.1

Light reflects off of the Earth and is trapped in our atmosphere by greenhouse gases.

This warms the atmosphere significantly making life on Earth possible as we know it.

Many people associate the greenhouse effect with global warming. In fact, there is so much confusion, that these terms are sometimes used interchangeably. The greenhouse effect is naturally occurring on most planets, and it is necessary on Earth to maintain life as we know it.

Did you know?

Without the greenhouse effect, the temperature of the Earth might be as much as 30 $^{\circ}$ C cooler! That would alter the surface of the Earth significantly, covering much of it with ice. We need the greenhouse effect to survive on Earth.

However, there can be too much of a good thing. Human beings have begun adding a large amount of greenhouse gases, primarily carbon dioxide, into our atmosphere. This came mostly with the industrial revolution when we began to burn coal and gasoline, and now many other fossil fuels (such as propane, natural gases), and even wood, in great quantities. With this increase in carbon dioxide in our atmosphere, there is more gas to absorb energy. With more energy being absorbed, the temperature of the atmosphere is beginning to increase, causing changes within our weather patterns, and other influences on the ecosystems of the Earth. This is called climate change.

In the past few decades the population of the Earth has doubled to over six billion people. These six billion

people foster a large increase in automobile transportation; the major source of the increase in greenhouse gases. The greater population has also required more resources such as land. Large amounts of forest have been cut down. Trees are one of the most important organisms that actually remove carbon dioxide from the atmosphere during photosynthesis. So not only are humans adding more carbon dioxide to the atmosphere, but they are also destroying trees that would otherwise be helping to absorb excess carbon dioxide from the atmosphere.

We will not know the full impact of global warming until perhaps the middle of this century. This is because it takes so long for the full impact to be felt. You may remember that water vapour and carbon dioxide are a very small part of the makeup of our original atmosphere (see Module 5, Tutorial 1). So as we add carbon dioxide from burning fossil fuels there is only a very small change in the makeup of our atmosphere. In fact it takes a long time for the atmosphere to mix in the added greenhouse gases fully. Scientists say that even if we halted the release of greenhouse gases today, the climate would continue to warm until about the year 2050 as the atmosphere reaches a new stable state.

3.2.1.4 Activities

3.2.1.4.1 The Greenhouse effect

To see how greenhouse gases affect the climate try this simulation from PhET. Explore the atmosphere during the ice age and today. What happens when you add clouds? Change the greenhouse gas concentration and see how the temperature changes. Then compare to the effect of glass panes. Zoom in and see how light interacts with molecules. Do all atmospheric gases contribute to the greenhouse effect?

Phet: The Greenhouse Effecthttp://phet.colorado.edu/en/simulation/greenhouse[7]

3.2.1.4.2 Human's influence on greenhouse gas concentrations

Take a look at http://www.breathingearth.net/[8] to see how much CO2 is currently been released into the atmosphere.

Watch for 4 minutes. How many people were born in that time? How many people died?

If the current grade 9's repeated this exercise exactly one year from today, at exactly the same time of day, by how much will the world's population have grown? Do you think this is a problem? Why?

How much CO2 will have been added to the atmosphere by that time? How does South Africa compare to the rest of the world? Do you think all South African's contribute equally to CO2 emissions in our country?

3.2.1.4.3 Discovering your impact

What Is A Carbon Footprint?

A carbon footprint is a measure of the impact our activities have on the environment, and in particular climate change. It relates to the amount of greenhouse gases produced in our day-to-day lives through burning fossil fuels for electricity, heating and transportation etc.

The carbon footprint is a measurement of all greenhouse gases we individually produce and has units of tonnes (or kg) of carbon dioxide equivalent.

A carbon footprint is made up of the sum of two parts, the primary footprint and the secondary footprint.

The primary footprint is a measure of our direct emissions of CO2 from the burning of fossil fuels including domestic energy consumption and transportation (e.g. car and plane). We have direct control of these.

The secondary footprint is a measure of the indirect CO2 emissions from the whole lifecycle of products we use - those associated with their manufacture and eventual breakdown. To put it very simply – the more we buy the more emissions will be caused on our behalf.

To work out what your carbon footprint is visit: http://www.carbonfootprint.com/calculator.aspx[9]

[7] http://phet.colorado.edu/en/simulation/greenhouse
[8] http://www.breathingearth.net/
[9] http://www.carbonfootprint.com/calculator.aspx

To discover how to reduce your carbon footprint visit: http://www.carbonfootprint.com/minimisecfp.html[10]

3.2.1.4.4 Climate Change

Student's guide to climate changehttp://www.epa.gov/climatechange/kids/index.html[11]
http://climate.nasa.gov/[12]
http://climate.nasa.gov/imagesVideo/climateReel/index.cfm[13]

3.2.1.5 Assignment:

Identify the ABC's (abiotic, biotic and cultural characteristics) of a natural environment near you. To make your ABC profile, follow the instructions below.

1. Select an area that is undeveloped (i.e. no buildings, no pavement, no bulldozing, no spraying of pesticides, no farming, no grazing, etc.). Your area must be at least the size of a soccer field. For some this will be an easy walk from their homes. Others will have to travel quite a distance[U+2011][U+2011]lucky you! You can think of it as a field trip. Make a map of your province and show, approximately, where your area is located.

2. Identify the at least 10 "A" (abiotic) features of your area. Consider factors such as:

* Landforms (mesa, mountain, valley, bench, etc..
* Altitude

3. Identify at least 15 "B" (biotic) features of the area. (You may use common names.) Consider things such as:

* Plants (trees, shrubs, grasses, flowers, etc.)
* Insects (ants, bees, praying mantis, etc.)
* Amphibians, reptiles, and/or fish

4. Identify at least 3 "C" (cultural) components. Look for evidence of human influence. Consider things such as:

*Recycling, conservation efforts
*Pollution
*Introduced species

ANALYSIS

NB- Come back and use South African examples for the model answer examples

Examine the data you collected when making your ABC profile. Use your collected data to answer the following questions.

1. What effect does the environment (abiotic) have on the organisms (biotic) living there? Give FIVE specific examples from your profile. [For example: Lily pads (biotic) are able to grow in my area because it is a natural wetland that has standing, stagnant water (abiotic) all year long.]

2. What effect do the organisms (biotic) have on the environment (abiotic)? Give THREE specific examples from your profile. [For example: The area is heavily shaded by spruce trees (biotic). The shade keeps the soil moist (abiotic) and reduces the air temperature.]

3. How do natural forces affect the area? Give ONE specific example from your profile. Consider the direction of the prevailing winds, the direction from which the sun's rays come, gravity (if you are on a slope), etc...

4. How have humans affected your area? Give ONE specific example.

5. Predict how your area would change if the amount of rainfall doubled. Be sure to mention how this increase in rainfall would affect the abiotic and biotic factors.

[10] http://www.carbonfootprint.com/minimisecfp.html
[11] http://www.epa.gov/climatechange/kids/index.html
[12] http://climate.nasa.gov/
[13] http://climate.nasa.gov/imagesVideo/climateReel/index.cfm

3.2.1.6 Discussion Points

3.2.1.6.1 The Tragedy of the Commons

From: http://cnx.org/content/m16743/latest/?collection=col10548/latest (AP Environmental Science: Environmental Ethics) from Connexions

In his essay, The Tragedy of the Commons, Garrett Hardin (1968) looked at what happens when humans do not limit their actions by including the land as part of their ethic. The tragedy of the commons develops in the following way: Picture a pasture open to all. It is to be expected that each herdsman will try to keep as many cattle as possible on the commons. Such an arrangement may work satisfactorily for centuries, because tribal wars, poaching and disease keep the numbers of both man and beast well below the carrying capacity of the land. Finally, however, comes the day of reckoning (i.e., the day when the long-desired goal of social stability becomes a reality). At this point, the inherent logic of the commons remorselessly generates tragedy.

As a rational being, each herdsman seeks to maximize his gain. Explicitly or implicitly, more or less consciously, he asks: "What is the utility to me of adding one more animal to my herd?" This utility has both negative and positive components. The positive component is a function of the increment of one animal. Since the herdsman receives all the proceeds from the sale of the additional animal, the positive utility is nearly +1. The negative component is a function of the additional overgrazing created by one more animal. However, as the effects of overgrazing are shared by all of the herdsmen, the negative utility for any particular decision-making herdsman is only a fraction of -1.

The sum of the utilities leads the rational herdsman to conclude that the only sensible course for him to pursue is to add another animal to his herd, and then another, and so forth. However, this same conclusion is reached by each and every rational herdsman sharing the commons. Therein lies the tragedy: each man is locked into a system that compels him to increase his herd, without limit, in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons. Freedom in the commons brings ruin to all.

Hardin went on to apply the situation to modern commons. The public must deal with the overgrazing of public lands, the overuse of public forests and parks and the depletion of fish populations in the ocean. Individuals and companies are restricted from using a river as a common dumping ground for sewage and from fouling the air with pollution. Hardin also strongly recommended restraining population growth.

The "Tragedy of the Commons" is applicable to the environmental problem of global warming. The atmosphere is certainly a commons into which many countries are dumping excess carbon dioxide from the burning of fossil fuels. Although we know that the generation of greenhouse gases will have damaging effects upon the entire globe, we continue to burn fossil fuels. As a country, the immediate benefit from the continued use of fossil fuels is seen as a positive component. All countries, however, will share the negative long-term effects.

3.2.1.7 Additional Resources

3.2.1.7.1 Plants can tell us about climate change

See how the general public are helping scientists monitor climate change by observing the timing of leafing, flowering, and fruiting of plants (plant phenophases).

Project Budburshttp://neoninc.org/budburst/[14]

3.2.1.7.2 Ecology site

http://www.ecology.com[15]

[14] http://neoninc.org/budburst/
[15] http://www.ecology.com/

3.2.1.7.3 The Story of Stuff

To see how humans can affect the environment: watch "The story of stuff": http://youtu.be/9GorqroigqM[16]

3.3 Ecotourism[17]

3.3.1 Ecotourism

Definition 3.1: Ecotourism
Tourism in natural environments to observe wildlife, often that are under protection or contain endangered species. It also refers to the practise of travelling to areas in order to support conservation efforts and uplift the lives of local people.

3.3.1.1 The attractions of touring South Africa

South Africa is a beautiful country that boasts great diversity in its flora and fauna. There are many interesting cultural, historical and environmental place that people from South Africa and other countries want to visit.

From what you learned from the different ecosystems, you can see that South Africa has a range of systems from desert, wetland, mountains, sea and our own unique Fynbos biome.

South Africa encompasses about 1,200,000 km2 and has about 10% of all plant species on Earth. It is the third most biodiverse country in the world, and together with seventeen other countries, is considered mega diverse which means those countries contain 70% of the planet's biodiversity. South Africa's unique geography allows the country to support such a diverse population of plants and animals. This makes South Africa an interesting travel destination to many.

3.3.1.2 Benefits to visitors, locals and the environment

Eco-tourism is a mutually beneficial practice for visitors, locals and the environment.

Eco-tourism has the potential to alleviate poverty in South Africa through bringing money into the economy and creating jobs for locals, while at the same time turning our great biodiversity and natural resources into a national asset that will be nurtured, protected and grown. Tourism is the fastest growing part of the South African economy

3.3.1.3 Ethical Issues

3.3.1.4 How to be a responsible ecotourist

Activity: debate about ecotourism.
Games online
Maintaining balance – minimising impact on environment eg organisations
Career: interview with a conservationist, game ranger
IKS: trackers
http://ethemes.missouri.edu/themes/1382[18]

3.3.1.5 Rich media

3.3.1.6 Assignments

[16] http://youtu.be/9GorqroigqM
[17] This content is available online at <http://cnx.org/content/m41355/1.1/>.
[18] http://ethemes.missouri.edu/themes/1382

Chapter 4

Diversity, change and continuity

Glossary

E **Ecotourism**

Tourism in natural environments to observe wildlife, often that are under protection or contain endangered species. It also refers to the practise of travelling to areas in order to support conservation efforts and uplift the lives of local people.

H **Human locomotion**

the ability you have to move from one place to another (walking from your house to a friend's)

L **Locomotion**

Movement or the ability to move from one place to another.

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